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ELECTRICAL EDUCATION IN CANADA.

It is with no little pleasure that we direct attention to the excellent work that has been done at McGill University, Montreal, in providing for electrical engineering education in its higher ranges. Probably the equipment is without its equal on this continent in modernity and completeness of detail. Of course, this unusually liberal expenditure would not have been possible without some noble private generosity, and McGill is to be heartily congratulated on having such ready benefactors as her McDonalds and Redpaths; as well as upon the sound judgment which turns these gifts to so felicitous a use. Even at the risk of seeming a trifle ungracious, we cannot refrain from expressing the hope that in the future benefactions to electrical engineering study may come in more handsome measure from those who during the last quarter of a century have been accumulating their millions from the application of electrical discovery. With them, that which to Sir W. McDonald has been the free-handed employment of wealth without any obligations to the art, must surely present itself in the nature of a duty.

Montreal thus becomes once again of growing interest to the electrical engineer. Next to Niagara, she counts now in the matter of the electrical exploitation of large water powers, and as has been shown, her educational resources are on the same grandiose scale. It strikes us that the American Institute of Electrical Engineers might do worse than include Montreal in its itinerary to the Buffalo Exposition next year. Another idea that occurs to us is that our English educational friends might well consider the value that McGill ought to be to engineering students. We understand that even to-day the University receives men from England and her colonies, but it would seem that her resources would be particularly attractive to electrical students from the old country. They would still be under their national flag, but they would have the latest and best facilities for study and would, moreover, be in closest access to the latest practical work of the popular American type. It should surely pay McGill to reach out for English students.

TRAIN LIGHTING.

The abstract which we present in this issue of the papers on train lighting read at the Paris International Railway Congress receive striking emphasis from the recent sad accident in Germany, near Frankfort, when as the result of a collision the gas lighting tank exploded, the train took fire, and several persons were burned to death under the most horrible conditions. The incident appears to have created great excitement and interest in the German Empire, and an agitation is now going on in favor of electric train lighting. The subject has been discussed at a recent meeting of the Electrical Society, at Berlin, when a very hopeful view was taken by many speakers of the future of such work. In fact, one of the speakers asserted that already some 8000 carriages are electrically lighted.

It will be noted that in both the reports which we abstract, great emphasis is laid upon this very feature of safety, of which, indeed, too much cannot be made, even although there seems to have been of late years a general freedom from serious accident. But now that acetylene has been introduced, the risks would appear to have increased seriously, and electricity alone remains pre-eminently safe. There is a curious absence in the reports before us of reference to

American practice, but it must be obvious that this country with its long railroad lines and its national habit of night travel is the one that ought naturally to be looked to for a solution of the problems involved in this important subject. Indeed, the work that is being done here justifies the strongest faith in abundant success. We note that the reports say that even now nothing but electricity will do for special cases and for important people such as kings and queens. In this country nothing short of the best equipment will do for the general public; and that which the president of a road puts on his private car is destined for the ordinary coach. Moreover, the growing magnitude of their electrical installations makes it daily more feasible for any of the roads to light their trains electrically with the highest economy.

The Steam Engine in Electrical Work.

Elsewhere in this issue we print a paper read by Mr. H. G. Reist before the recent annual meeting of the Engine Builders' Association of the United States, which contains a lucid statement of the present situation with respect to the steam engine in its relation to electrical generation. Of the three great factors which during the past half-century have so profoundly affected the development of the steam engine—marine propulsion, textile manufacture and electrical generation—the latter has perhaps involved the most severe demands—at least in detail—on the engine builder. At the beginning, about twenty years ago, of the electrical era, the engine builder was called upon to meet radical requirements with respect to high speed and regulation, the solution of which involved the development of practically new types of engines. More recently the requirements of alternating current working have presented the problem of harmonizing regulation, in the ordinary meaning, with uniform speed of rotation. As pointed out by Mr. Reist, for parallel operation of alternators and to assure the satisfactory operation of synchronous motors and of converters, the variation in uniformity of speed during a revolution must not exceed an amount corresponding to a small fraction of a degree in displacement. The introduction of the Rites principle in governing and the addition thereto of retarding mechanism have enabled this and other new requirements of recent years to be met in at least a passably satisfactory manner.

In this issue we also print a report of the proceedings of the Engine Builders' Association, which deals with the questions of overload capacity and of the standardization of such parts of engines and generators as are mechanically related to each other. The engine builder has every reason to desire some convention as to overload capacity, or, to put it more broadly, to desire that the rating of dynamos may be placed upon some fixed basis corresponding to engine rating. The report of the committee on standardization of the American Institute of Electrical Engineers, which report was formally adopted by that body, recommends as the limit of overload capacity 25 per cent for periods of one-half hour, which, however, is lower than what at present obtains in practice. As to the standardization of shafting, there is a radical difference between the factors affecting the design of generator and engine shafts, and the situation would appear to require that the engine builder should in this accommodate himself to the electrical manufacturer. The size of an engine shaft is fixed by the greatest torque which it has to overcome, while the size of a dynamo shaft—and this also applies to its method of support—is fixed by the strain set up through deviations from magnetic balance by the armature, which introduces the additional factor of rigidity.

There is no reason why a convention should not be arrived at which would be satisfactory not only to manufacturers but also agreeable to consulting engineers, and which would benefit both the steam and electrical industries without being carried to an extreme that would retard development. This latter point is one, however, which should not be lost sight of, for the principle of standardization carried too far, particularly in the absence of general competition, is apt to retard advancement, as was so well illustrated some years ago when our central stations were filled with belted bipolar "standards" long after the present type of direct-connected central-station generator had been brought into general use abroad.

Central Station Charges.

We printed in these pages last week an interesting article detailing how one careful station manager has met the question of proper charges for motor service. His method is to superimpose upon a flat charge per kw-hour of energy, a graded charge for the capacity demanded. This is certainly a considerable improvement over the simple meter rate, and ought to commend itself to many who have been wrestling with similar conditions. In modern plants using induction motors the matters of capacity of the motors and the maximum call for current are peculiarly important, for under ordinary load conditions the so-called wattless current is by no means negligible. In such case, however, underloads are as troublesome as overloads, and the charge could very properly be fixed on the basis of a wattmeter charge plus an ampere-hour charge.

In the case of many plants carrying induction motors, there are on an average many motors running idle or greatly underloaded. If such a condition of affairs continues into the "lapload" period it means trouble with the regulation. The station manager can defend himself only with difficulty, and probably his most effective weapon is a charge based on ampere-hours or on this and watt-hours combined. He should also exercise some supervision over the motors installed on his circuits, and if he finds a customer installing a motor much too large for its work, he should point out to him plainly that he is not only paying for too much motor, but that it will increase his bills every hour that he runs it.

When it comes to arranging a schedule of motor rates, however, we must firmly adhere to the position that plain, every-day equity demands that a customer shall on the one hand pay for all that he gets, and on the other hand shall not be charged for what he does not receive. If a charge based on maximum output is made, as it very properly may be, there should as a matter of right be made a difference between the man who calls for a certain power once or twice a month and the man who makes the same demand every few minutes. If the same capacity rate is charged the two, either the former is grossly overcharged or the latter, who is by far the more troublesome of the pair, is unduly favored. To say, as does our esteemed correspondent, that this difference is the property of the station, is simply denominating it as an overcharge which can be extracted from the less exacting customer. Now in the long run the public finds out when prices are being unduly juggled with, and finds some effective way of getting square.

It is a tough problem, this finding an equitable way of charging for motors of variable output, but it is worthy of very serious consideration, for motor service is growing every year, and will grow faster in the future than it has in the past. In the old days of contract rates the difficulty was met by a charge arbitrarily varied to meet the case, and even although contract rates are now fallen into disrepute, this method has elements of fairness which a flat meter rate lacks. Some combination of current rate and energy rate, however, should be able to give a basis of charges entirely fair to both parties. A little educa-

tion of the public in the facts of the case would be a good thing. The average user of electric power does not realize the bearing of his output on the operation of the central station, and often misunderstands through sheer ignorance. But the most important single service which the station manager can do his customer is to see that the motors installed are of the right kind and size to do the most effective service; and a little advice at the right time may save much trouble and wrangling later on.

THE USE OF IRON CONDUCTORS FOR ALTERNATING CURRENTS.

An interesting article, by H. Eisler and L. Kallir, appears in a recent number of a foreign contemporary, upon the subject of bare overhead conductors for high-tension alternating currents. In this article the relative commercial advantages of copper, aluminum and iron are compared. It is shown that while aluminum costs by weight in reference to copper in the ratio of 5 to 3, an aluminum wire is 17 per cent cheaper than a copper wire for the same conductance. The rule connecting copper and commercially pure aluminum is easy to remember, and is that an aluminum wire half the weight of a copper wire has the same conductance; or, expressed in another way, if a commercially pure copper wire weighs, say, 100 lbs. and a commercially pure aluminum wire of the same length weighs 50 lbs., then the two wires will have approximately the same resistance, or conductance, or be equally serviceable for electric transmission purposes as bare overhead conductors. Consequently, so long as the price of aluminum is less than double that of copper, there is a theoretical advantage in employing aluminum for bare overhead conductors or for bus-bars. It is well to bear in mind the theoretical condition, because the aluminum wire requires to be more carefully tested, selected and erected, since commercially pure aluminum wire has less than two thirds the tensile strength of an electrically equivalent hard-drawn copper wire. The jointing of aluminum wires is also a more troublesome matter than the jointing of copper wires, so that it cannot be said that the two metals are capable of exact commercial comparison until a few years experience has been gained with the use of aluminum under conditions of actual service.

The article points out that although iron has seven times less conductivity than copper, yet, owing to its cheapness, iron and aluminum are almost on a par electrically so long as the skin effect may be neglected. This skin effect, which is usually negligible in commercial sizes of copper or aluminum wire at commercial frequencies, is a large factor in iron. Moreover, the skin effect in the two non-magnetic metals is practically independent of the current strength; whereas, in iron the skin effect varies with the current strength. Consequently, in order to define the resistance of an iron wire including the effects of steady current resistance and skin effect, but excluding the effects of inductance, the term "effective resistance" is employed, which is the ratio of the power expended in the iron wire expressed in watts, to the square of the current strength carried by the wire expressed in amperes squared, the ratio being then expressible in ohms, and being always in excess of the resistance accompanying and corresponding to steady currents.

Even when steps are taken to minimize or obviate the skin effect in iron, it is doubtful whether it would be commercially practicable to employ overhead iron conductors for alternating currents. If a copper wire is replaced by its equivalent aluminum wire, the weight of metal is reduced 50 per cent; but if it be replaced by its equivalent iron wire the weight is increased at least fivefold. This extra weight would be relatively expensive to support, and insulate. The only conditions under which iron can compete with copper for alternating current conductors would perhaps be in connection with the track of a railway system where it might form the return circuit when the rails were thoroughly bonded.

COMMERCIAL ELECTRICAL TESTING.

It is both interesting and instructive to compare the methods of modern commercial electric testing with those which existed as recently as twenty years ago. At that time nearly every electrical measurement involved the use of the Thomson mirror galvanometer, or, occasionally, a mirror electrometer. The little glass mirror with a minute magnet fastened on its back was the central and essential feature of the entire set of apparatus, and everything was arranged with reference to the action and behavior of the reflected beam of light upon the divided scale. It is remarkable how far this wonderfully simple and delicate instrument has passed out of general use within a few years. The dyanmo may be said to have, in a certain sense, destroyed it, for the dynamo either directly, by its powerful field magnets, or indirectly, by the powerful electric currents it generated, invaded the earth's magnetic field, and affected the constancy and reliability of the galvanometer needle's deflections.

The instrument which has taken the place of the Thomson mirror galvanometer is the d'Arsonval galvanometer with the small moving coil and large fixed magnet in place of the large fixed coil and small moving magnet. Here the external magnetic field due to the earth's magnetization is trivial compared with the internal magnetic field due to the fixed magnet. The advantage of the so-called d'Arsonval type of apparatus, which, however, considerably antedates the first d'Arsonval galvanometer, is enormous from a practical standpoint, for the instrument may for most purposes be oriented in any manner without special reference to the earth's magnetic field; and, moreover, stray magnetic fluxes due to currents and magnets in the neighborhood are usually of insufficient importance to affect the indications of the instrument. In one direction the d'Arsonval instrument cannot compare with the earlier Thomson galvanometer; namely, in regard to sensibility, since the mass of a movable mirror is so much smaller than the mass of a movable coil; in addition, the mirror requires no electric connections, whereas, the movable coil requires flexible electric connections to be attached to it, with the inevitable result of increasing its torsional resistance. The full sensibility of the mirror galvanometer is, however, seldom required, and only in exceptional cases has it to be resorted to. For ordinary electrical measurements, the sensibility of the d'Arsonval instrument is amply sufficient. In this apparatus, with a given form and disposition of moving parts, the torque exerted by a given current strength increases with the magnetic flux density in which the coil lies. Consequently, with a high magnetic density, the ampere-turns required for full deflection in the movable coil are reduced to a surprisingly small amount.

In the days of the Thomson galvanometer, resistances in ohms, by differential methods, or Wheatstone bridge, were practically the only quantities directly read in electrical units. Almost all other magnitudes, such as volts and amperes, had to be computed and were not directly observed. This was a condition brought about by the dependence of the galvanometer deflection upon the locally varying intensity of magnetic field at the instrument. The production of direct reading instruments such as voltmeters, ammeters and wattmeters was a great stride from a practical and labor-saving point of view. The tendency for the future is in the same direction to producing direct reading instruments for the various other magnitudes used by the electrical engineer.

Meeting of the Underwriters' National Electric Association.

This association held its annual meeting in New York on Dec. 11 and 12. There was a large attendance of delegates from all over the country and some important decisions were reached regarding changes which are to be made in the National Electrical Code of 1901, but the proceedings were marked by a tendency of the members present to leave two or more alternative courses open in the rules that attracted their greatest attention. The motion to change the limit of low-tension circuits from 300 to 550 volts was carried at the first session. During this session, also, a long discussion took place on the advisability of grounding one of the wires in low-tension circuits, in which numerous authorities were quoted; and prominent electrical engineers spoke in its favor. The resolution was finally adopted to allow the grounding of one wire in every low-potential circuit, but making it optional with the installing engineer.

The committee on slow-burning insulation reported on a new style of insulated wire, and recommended its optional use for a year with the present form. The new style reverses the positions of the slow-burning and weather-proof layers. One layer of the latter is placed next to the copper and two layers of the braid containing the approved slow-burning compound surrounds it. The resolution offered to make both of these wires comply with the requirements was passed. Much work was reported by the committee on the carrying capacity of aluminum wire, and the results of a long series of tests show that insulated aluminum wire has a safe carrying capacity 84 per cent that of similarly insulated copper wire of the same size, while bare aluminum wire has only 77 per cent the capacity of the corresponding size in bare copper. These figures will be incorporated in the new code.

Annual Meeting of the British Westinghouse Company.

The first annual meeting of the British Westinghouse Electric Manufacturing Company, Ltd., was held in London on Nov. 23, with the Hon. R. C. Parsons, chairman of the executive committee, presiding. In the course of some very interesting remarks he said that their sales during the financial year had amounted to £550,000. This was eminently satisfactory, especially as in the prospectus presented when the company was formed it was stated that the turnover during the previous year was £266,528. During the month of October last they had made sales to the amount of £32,550, and up to the present date in November sales amounted to £31,890. At present they were simply trading with the machinery procured from the American company, and when their works at Manchester are completed they look forward, naturally, to the trade being very much larger. In addition to these figures they had absolutely in view another £40,000, and they were preparing further tenders for sales of £104,000. He said:

"Now the position of the company is a peculiar one. Although the American company had been trading here for some years, and had made a considerable position for itself, still this concern that we are engaged upon now is a very difficult one. We are extending at a very rapid rate; we are putting together a manufacturing company which will have a staff of from 3000 to 5000 men employed presently." In spite of the heavy charges for freight a profit was made of £10,777. Regarding the new works he showed the plans for the Manchester shops, and said: "Here you have a general plan, showing the works as they are intended to be constructed. This shop is for the purpose of turning out every class of electrical machinery, this one for steam engines, and this for gas engines of large size. The large shop will cover eight acres. The heavy machinery will be constructed on the ground floor of the works and the smaller machinery will be constructed on the floors above. The large machine shop is laid out in such a way that the machinery, as it comes from the iron foundry, the steel foundry and the brass foundry will be passed into the machine shops and come out the finished article on this side, where the boxing and packing will take place, and it will be sent over the lines of England or be exported abroad by the Manchester Ship Canal. I may mention that the property there is connected with all the lines of the country; so that the material which is purchased in the iron district, for instance, in the shape of iron and steel, will come over that line, and the finished article will be exported over the same. In regard to the coal supply, it will come from the Wigan district along the canal, which, as you see, goes past the works. You will see on the other plan the generating station. There will be a steam generating plant, and also a gas engine generating station side by side, and we shall be in the actual position to ascertain what are the relative advantages of our large gas engines and steam engines, and to make any tests which may be required." In regard to the completion of these works at Stafford Park, Manchester, Mr. Parsons stated that an issue of 25,000 preference shares of £5 would be made shortly, and that it had been fully underwritten. Reference was made to large work offering in England, including the electrification of the old Metropolitan Underground in London.

Annual Meeting of the Electrical Trades Society.

An interesting meeting of the Electrical Trades Society was held, as announced, at the rooms, 39 Cortlandt Street, New York City, on the afternoon of Dec. 11. The meeting was for the transaction of annual business, and the report presented by Secretary Eckert showed the accomplishment of a great deal of useful work during the year. The annual dues were raised from $25 to $30 to provide for the contribution to the national body, and Mr. R. E. Gallaher was elected the delegate of the society to the national convention meeting next March in Chicago.

The following board of directors was elected for the ensuing year: R. E. Gallaher, E. R. Gilmore, J. P. Marshall, H. A. Reed, J. B. Peck, G. L. Patterson, J. H. Dale. The board has elected the following officers: president, R. E. Gallaher; vice-president, E. R. Gilmore; secretary and treasurer, A. P. Eckert, so that the active management will continue in the hands of those whose vigilance and fidelity have already contributed so largely to the success and utility of this admirable institution for safeguarding the interests of the trade.

Some Figures on Street Lighting.

With regard to the amount of street lighting in different cities some interesting figures are cited by the New York *Sun*. It is stated that Chicago spends $600,000 a year in street lighting; Boston, $650,000; Cincinnati, $425,000; Baltimore, $350,000; San Francisco, $245,000; Providence, $250,000; New Orleans, $230,000; Cleveland, $325,000, and Washington, a city of long distances, low houses and wide streets, $235,000. New York will expend for street lighting in 1901 $2,745,000 for gas and electricity. Of this total Manhattan uses $960,000; Brooklyn, $950,000; the Bronx, $350,000; Queens, $355,000, and Richmond, $130,000. There are various reasons why the cost of public lighting should be proportionately much larger here than elsewhere. New York has a larger waterfront than any other American city. While other cities have usually one public market, New York has a dozen, and the eight included within Manhattan use on an average 5,000,000 cu. ft. of gas in a year. Many other American cities rent the premises they require for public departments, whereas New York owns most of her public buildings, and the gas bills, which in some other cases are met by private individuals, are in most cases here paid directly from the appropriation, which while nominally for street lighting, actually includes all forms of illumination for which the city is responsible.

New York has in all nearly 60,000 lamps, gas and electric. There are 30,000 in Manhattan and the Bronx, of which 24,286 are gas lamps, 4538 electric, and the others naphtha lamps. Brooklyn has 11,015 gas lamps and 4603 electric lamps. Queens Borough, the most extensive division of New York to be lighted, has 3839 gas lamps and 2106 electric lamps. Richmond, the most progressive of the boroughs of New York in this particular, has all electric lights—no gas. Of these 2883 are incandescent lamps and 382 are arc lights. There are, moreover, 100 oil lamps in use in Richmond Borough.

The extent of the territory to be covered and the peculiar conditions existing in New York explain to a great extent the reasons for so large an appropriation for illumination, nearly 3 per cent of the entire budget of the city, which is $100,000,000 for next year.

Electric Light and Power in Montreal.

In four years the number of electric lights used in Montreal has increased from 54,000 to 100,000. The Royal Electric Company has in operation 5000 horse-power in motors. The users of these motors have contracted with the company to run the machines only between the hours of 7 a. m. and 4 p. m. Thus the power load is entirely a day load and does not in any way interfere with the lighting service. The day load averages from 80 to 90 per cent of the lighting load, a condition that is believed to be unequalled anywhere in the world.

Operating Data of the Moving Sidewalk and Electric Railway at the Paris Exposition.

ONE of the most interesting features of the Exposition was the installation of the electric railway and moving sidewalk or platform, affording communication between the Invalides and Champ de Mars sections. It became one of the first duties of every visitor to walk along the moving platform, by virtue of its novelty, and the patronage was gratifying to the company operating these means of transportation; while the electric railway offered a quick and pleasant means of crossing from one part of the grounds to the other. The price charged for access to the platform was 10 cents (50 centimes), double that demanded for the railway, which was a more ordinary way of traveling. The lower price of the cars commended itself to the public, although there always remained some proportion of the crowd who wanted the ride on the wonderful platform. There is no doubt, however, that the expectations of the Compagnie des Transports Electriques were not realized in their full measure, as the receipts were much below what might reasonably have been anticipated. The figures are kindly furnished by Mr. Silz, of the company's engineering staff:

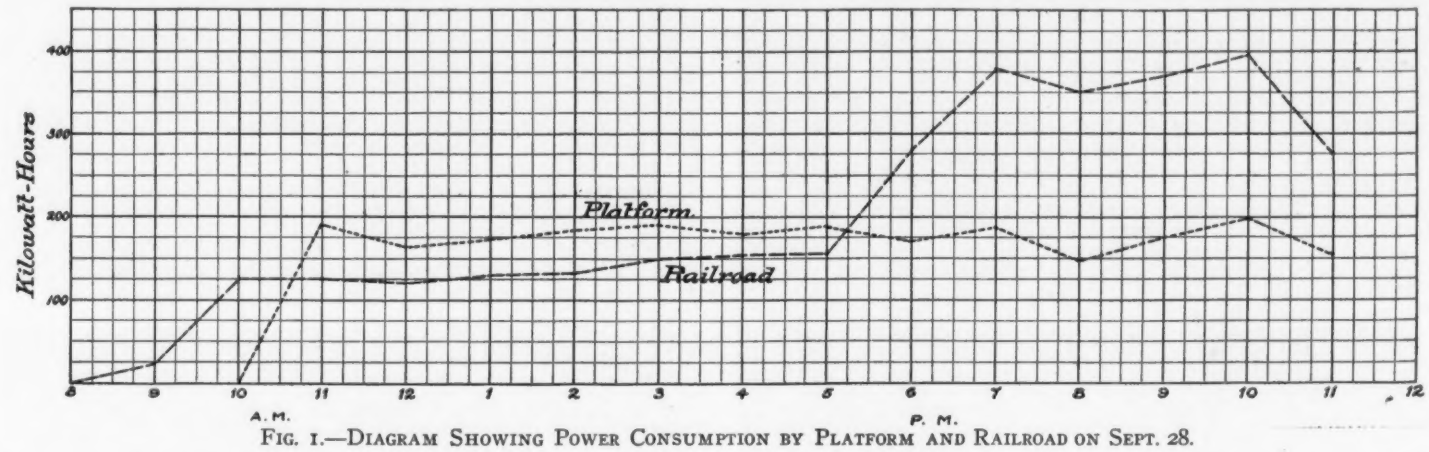


FIG. 1.—DIAGRAM SHOWING POWER CONSUMPTION BY PLATFORM AND RAILROAD ON SEPT. 28.

Paid places on moving platform,.....6,694,308
Paid places on electric railway.....2,635,867

It will be seen below that the railway was more effective as a means of transport, from a business point of view, that the platform. Usually there were six trains running, each being 30 metres in length, or a total of 180 metres. The speed, making a complete tour in 13 minutes, was double that of the platform, so that the length might be taken as 360 metres, for a working surface, or about one-tenth the length of the platform, while the number of passengers carried is not far from half the number who entered on the platform. The electrical equipment of the railway, and 120 of the motors for the platform, were supplied by the French Westinghouse Company, and the performance of this apparatus has been critically watched during the time of service through the summer. M. Henri Tripier, engineer in charge of the railway, says that he was especially interested in observing the daily operation of the apparatus on the cars, as the work required was so severe, on account of the heavy grades encountered; for the railway was of elevated construction for the most part, while all the stations were on the street level. M. Tripier has had on other occasions much trouble with controllers, manufactured by companies whom he did not name, and he believes that it is only fair to the Westinghouse Company to say that after more than six months of service the controllers show no signs of wear and are apparently in as good condition as if they had just come from the factory. The rest of the electrical equipment for the cars also called for his highest praise. It is to be observed that M. Tripier was very careful in the selection of his motormen, and that they were put through a preparatory training in the car sheds, amounting to a week or two, to familiarize them with the construction of the apparatus, and to insure an intelligent understanding of the mechanism employed. But such preparation is always advisable, although apparently not considered so by some of the tramcar companies of Paris, whose cars are driven recklessly, so that there are continually accidents to be recorded, one

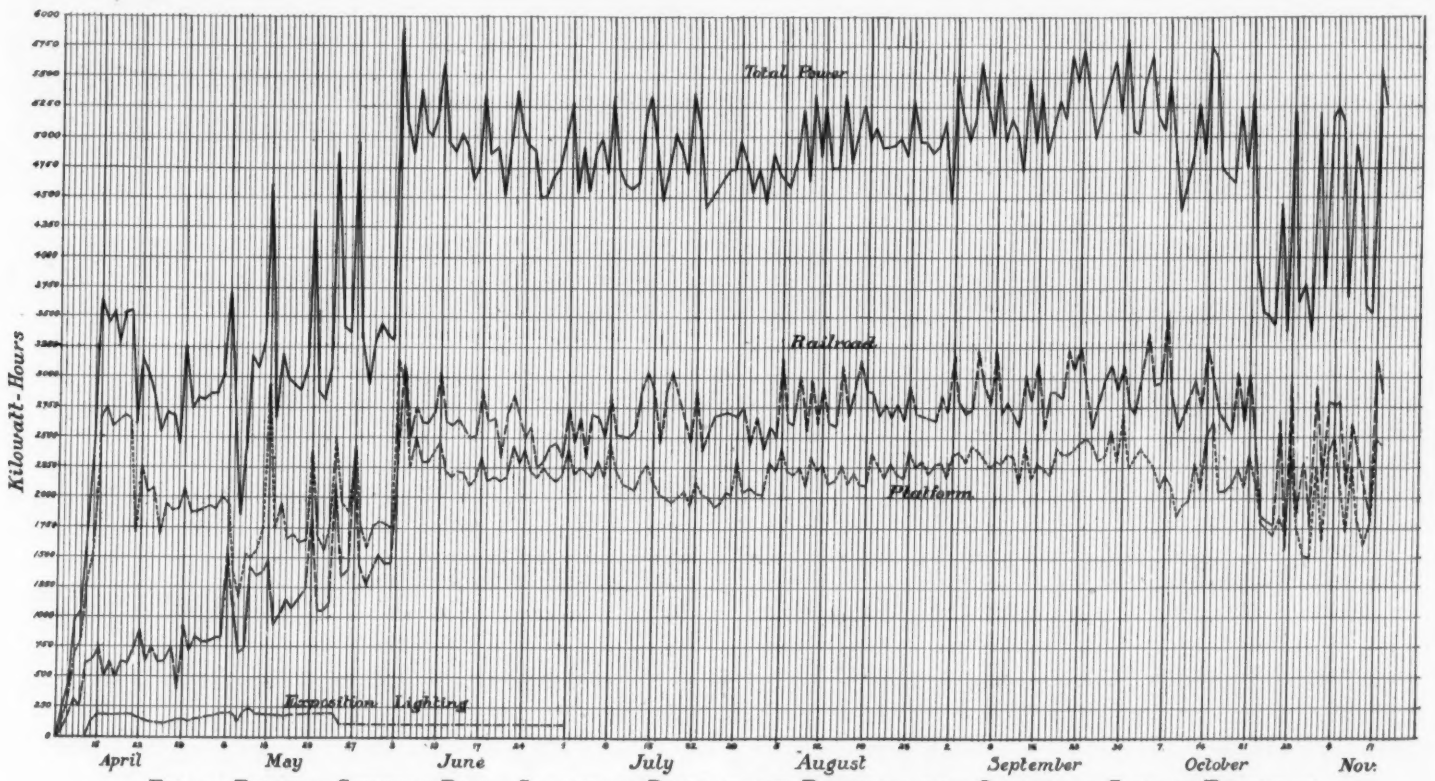


FIG. 2.—DIAGRAM SHOWING POWER SUPPLIED TO RAILROAD AND PLATFORM FROM OPENING TO CLOSE OF EXPOSITION.

or more almost every day for many weeks past, and sometimes five or six in one day.

Mr. Maurice Coster, of the French Westinghouse Company, has furnished us with some interesting information respecting the power required for the operation of the railroad and platform. It will be remembered that a sub-station was built on the Quai d'Orsay, within the Exposition grounds, the power being supplied from the new central station of the Western Railroad at Billancourt (Moulineaux). The curves shown on page 911 were laid out by Mr. J. T. Wolfe, engineer in charge of the sub-station. The larger diagram shows the total power supplied by the sub-station from a few days before the opening to the close of the Exposition (the full line), also the power taken by the railroad and platform individually (dash line and dotted line respectively), and power supplied for Exposition lighting (dot-and-dash line) from the inauguration until the end of June.

The latter curve shows, by its fall and stop, when the machines in the Palace of Electricity were ready for service. On July 1 the lighting from the sub-station was discontinued. The readings from which the curves are plotted are from the wattmeter, and give kw-hours. The railroad curve runs up continually, the power required being quite small at first and much less than that taken by the platform; but after June 3 the railroad experienced a great increase in patronage, and the curve crosses the platform curve. The peaks of load are seen to occur quite regularly on Sundays, when all Paris was out, and on the "select Fridays" after they were introduced in June. The variations in load on the last few days were very remarkable, presenting great fluctuation of power from one day to another. The platform settled down to a steady amount after the first few days in June, presenting, however, the same character of load variation as the railroad, except that the changes were less severe. This was due to the fact that the speed would diminish somewhat with heavy loading, as the motors were series wound.

The smaller diagram shows the wattmeter readings through the day of Sept. 28, taken every hour. The platform was started at 10 a. m., but the first reading was taken at 11 o'clock, and subsequent readings were given as the difference, or the readings from hour to hour. The railroad had also some lights on the circuit, these coming on gradually from 5 to 7 o'clock, and some printing presses were also run through transformers. The drop from 11 to 12 represents the hour of "dejeuner," and 7 to 8 o'clock is dinner time, when many people leave. The platform also falls a little in power consumption at this time. At 9 o'clock there was usually a gathering to see the fountains play, and as soon as they ceased, a general exodus took place.

Report of the Patent Commission.

The committee appointed to revise the statutes relating to patents, trade-marks, etc., has submitted a report of its conclusions to Congress. The commission consists of Francis Forbes, Peter S. Grosscup and Arthur P. Greeley. The changes which they recommend are embodied in three proposed bills, drafts of which they submit with the report. None of the provisions of these bills affects the general provisions of the patent law, but in the matter of trade-marks the commission recommends a complete revision of the present law, and a bill which covers the entire question is submitted.

Summarizing the results of the various hearings held by the members of the commission, they reach the conclusion that there is general agreement on the following propositions:

"First, that the international convention signed at Paris in 1883 is advantageous to the people of this country, and that the United States should provide for carrying out its provisions.

"Second, that the treaty relations of the United States, the interests of American manufacturers engaged in domestic trade, and particularly the interests of manufacturers engaged in foreign trade, demand a National trade-mark law, which, so far as Congress has power to do so under the Constitution, shall regulate and protect trade-marks used in commerce within the United States more satisfactorily than is now possible."

It also was generally agreed that, if the privilege of filing caveats under the same conditions as in the case of United States citizens could not be properly given to residents of foreign countries, the caveat should be abolished, it being generally considered that it is at the present time of little or no importance.

Electrical Engineering at McGill University.

THE extensive mineral wealth of Canada, and her abundant water powers, of which Shawinigan Falls, Chambly, Lachine, Hamilton and others recently developed are examples—make her a country splendidly endowed with engineering opportunities and indicate a magnificent field for the engineer. This situation has been grasped by one most interested in Canada's future progress, Sir Wm. C. McDonald, a wealthy manufacturer of Montreal, and an exponent of the doctrine that great wealth implies great benefactions to the public from which it has been derived. As a consequence, McGill University, of Montreal, possesses through his liberality one of the most thoroughly equipped of modern engineering schools.

McGill University, founded near the beginning of this century, rapidly assumed the first position among the educational institutions of the Dominion under the strong and efficient guidance of Sir Wm. Dawson. The engineering faculty was organized prior to his death some twelve or fourteen years ago, but credit for the subsequent and remarkably complete organization of all engineering work at McGill is most largely due to Prof. Bovey, now Dean of the Faculty of Applied Science, one of the five faculties of the University. The Faculty of Applied Science consists of the following departments: Mathematics, Prof. Chandler in the chair; Physics, President Cox and Prof. Rutherford: Chemistry, Profs. Harrington and Walker; Applied Mechanics and Civil Engineering, Dr. Bovey, Dean, in the chair; Geodesy and Surveying, Prof. McLeod; Mechanical Engineering, Prof. Durley; Mining and Metallurgy, Prof. Porter; Architecture, Prof. Capper; Electrical Engineering, Prof. Owens.

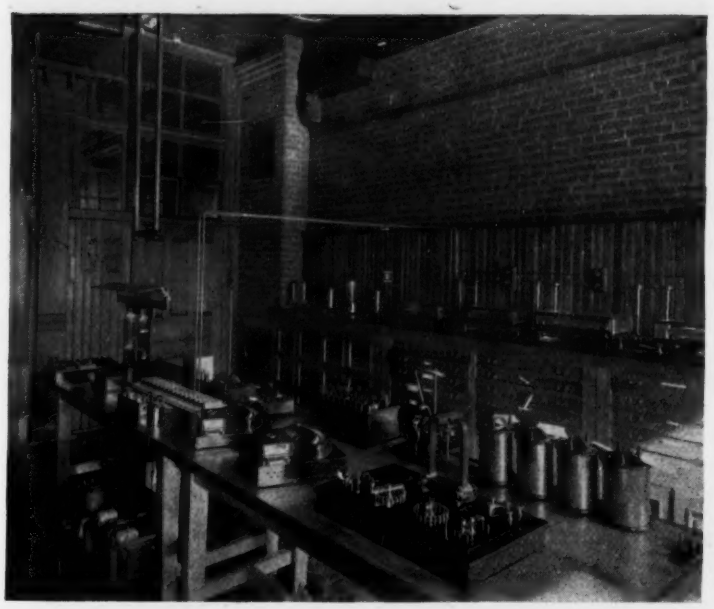
FIG. I.—ENGINEERING BUILDING.

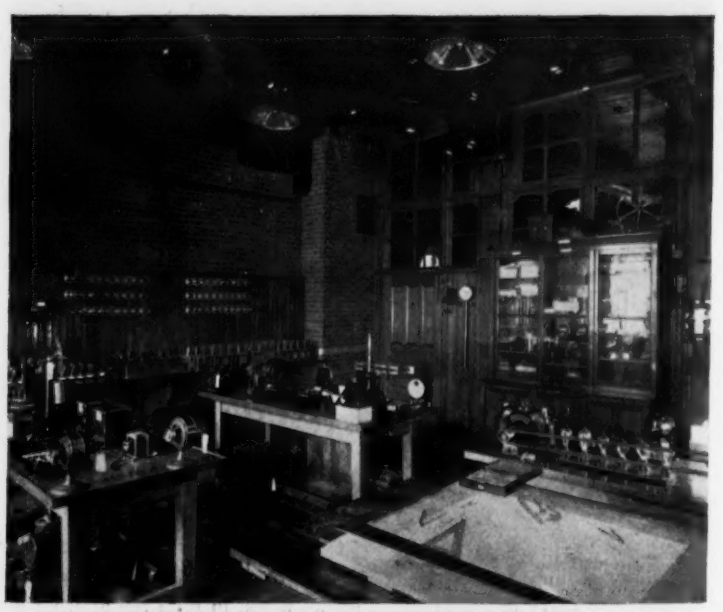
The guiding motive controlling all the work done in the Faculty of Applied Science is to inculcate the general scientific principles involved in engineering operations rather than to teach immediate engineering practice, which must necessarily change from year to year.

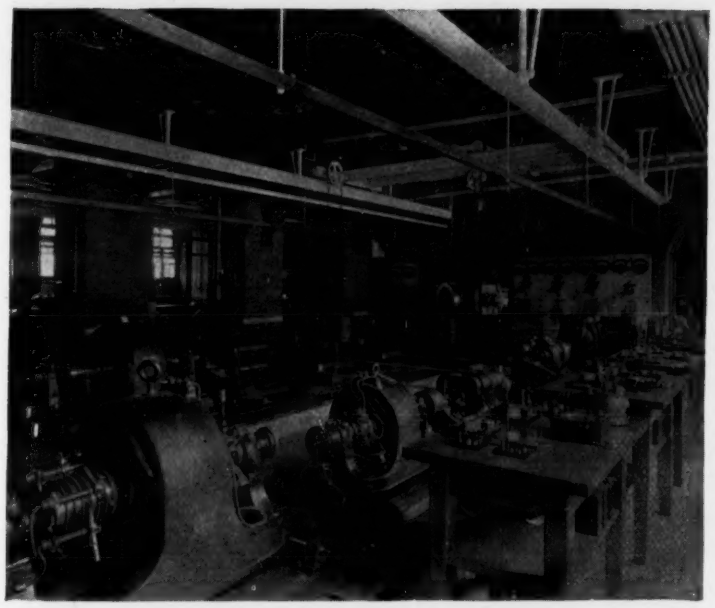
The engineering department is mainly located in three buildings, the McDonald chemistry and mining building, the McDonald physics building and the McDonald engineering building, each of which is magnificently equipped for the objects to be served. One of these is original research, and in this branch an enviable record has already been made, as instance the work of Callender on platinum thermometry; that of Rutherford on the ionization theory of gas conduction of Nicholson on cylinder condensation, and of Bovey, the latter covering a wide range, in strength of materials and hydraulics.

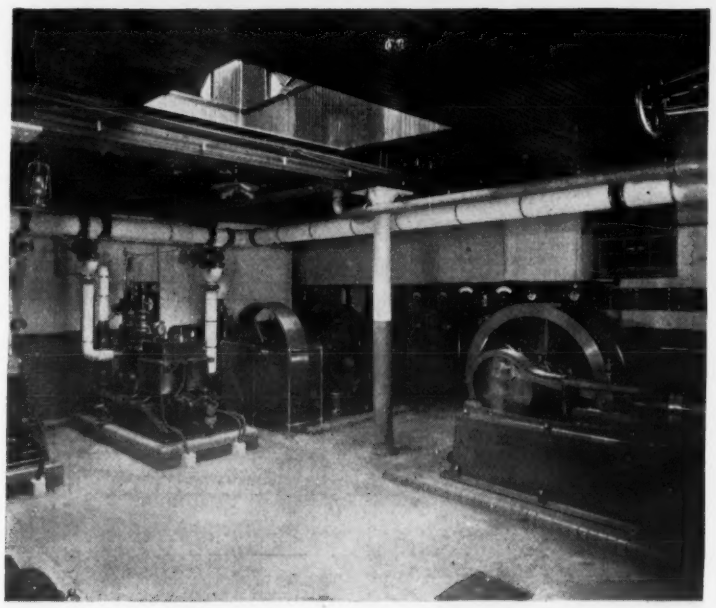
It may here be remarked that in the equipment of the various laboratories, material was not accumulated at random, but always with an eye to definite uses. The controlling idea in the use of the McGill equipment seems to be that of individual work as against class demonstration. The students in the electrical laboratories, for example, work in groups of three men each; to illustrate, each group is given, in the dynamo laboratory, a motor and a dynamo with suitable means of connecting them, together with testing tables suitably supplied with instruments and the means of absorbing power; banks of lamps, wire resistances, water rheostats, etc.

When Prof. Owens went to McGill to take full charge of the electrical department in 1898, the generosity of Sir Wm. McDonald sup-









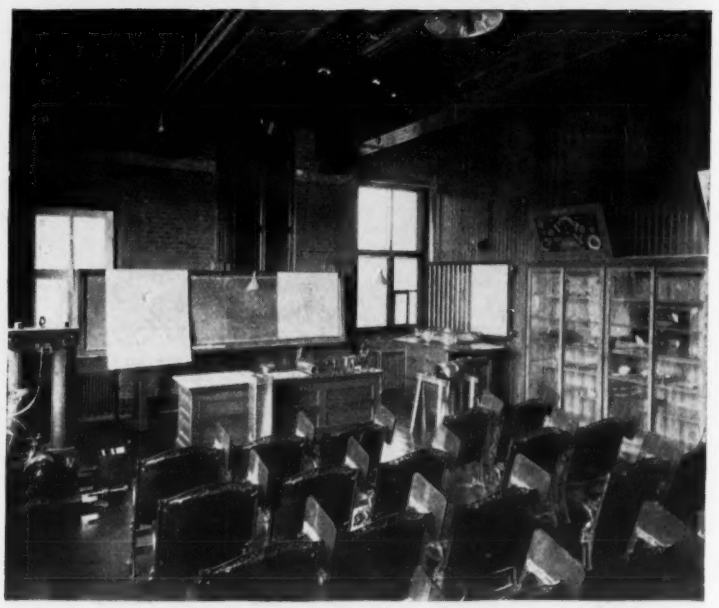


FIG. 2.—STANDARDIZING LABORATORY.
FIG. 3.—LABORATORY FOR SPECIAL RESEARCH.
FIG. 4.—DIRECT CURRENT LABORATORY.
FIG. 5.—HIGH-TENSION LABORATORY.
FIG. 6.—SERVICE PLANT.
FIG. 7.—LECTURE ROOM.

ELECTRICAL ENGINEERING AT MCGILL UNIVERSITY.

plied funds for a new and complete electrical equipment. As a consequence, the equipment of the electrical department is unique, differing from that of other similar universities which, as a rule, has been gradually accumulated and can thus contain little of the element of design. To carry out the plan of group work, in both the alternating and direct-current dynamo laboratories the dynamos and driving motors are mounted on parallel benches. Overhead in each laboratory is arranged a hand-operated traveling crane by means of which the position of all machines can be changed in a few minutes. The benches themselves are slotted like the bed of an ordinary planer, and each machine can be fixed in place by suitable wooden pins.

Four dynamos in the service plant, three sets of storage batteries having a maximum discharge of 100 amperes each, and two sets of supply circuits give nine independent sources of current supply. Elaborate switchboards are provided in the various departments. The distributing switchboard contains provision for ten supply circuits and twelve laboratory circuits. The dynamo laboratory circuits are carried in concrete ducts under the floor and along the edge of the testing benches, and are tapped under the benches at points equally spaced, connection being made to any machine through the insulated bayonet joint.

The main generating plant consists of two 75-kw 125-volt direct-

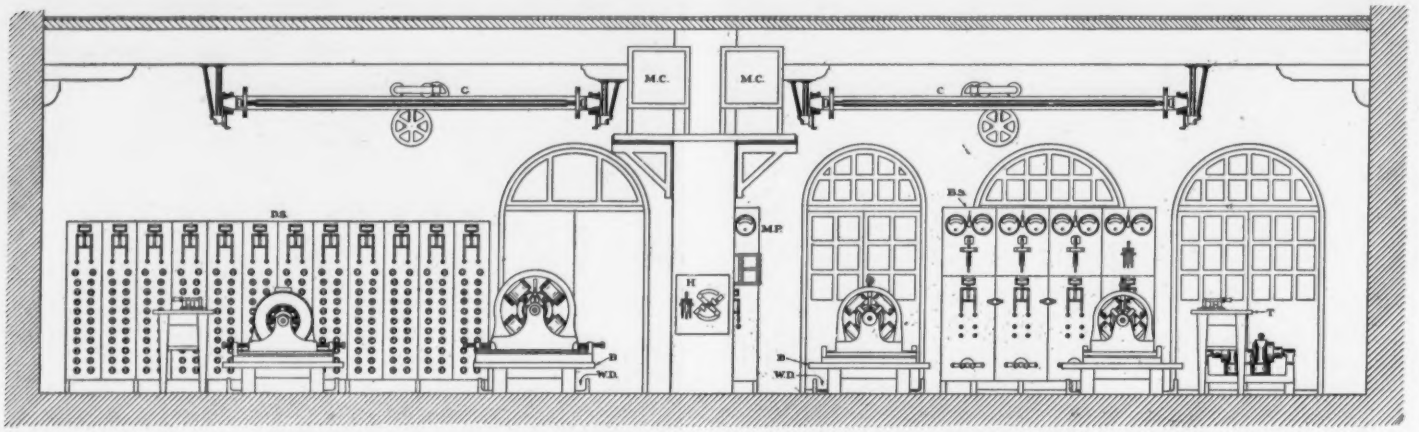


Fig. 8.—Side Elevation of Dynamo Laboratory.

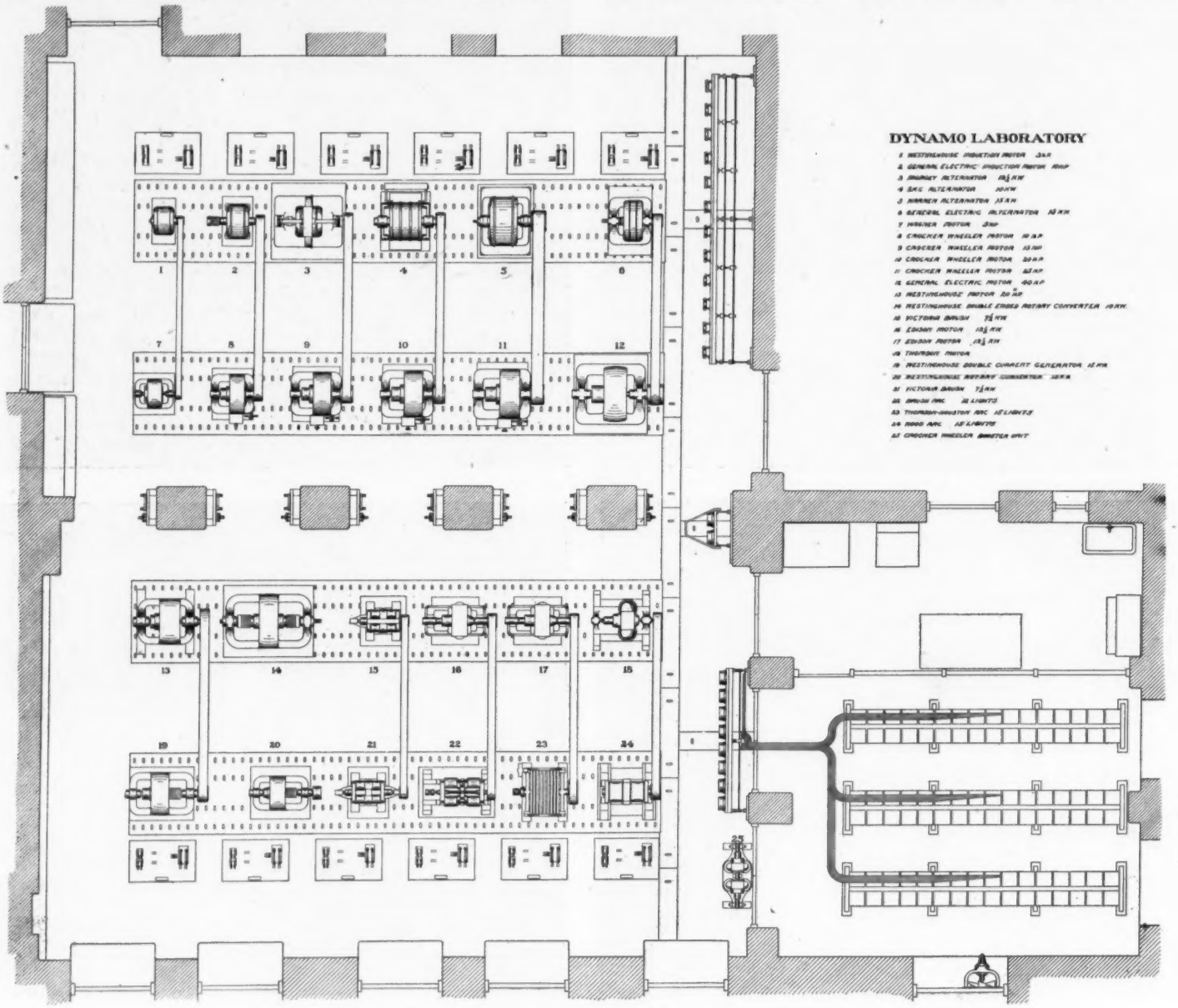


Fig. 9.—Plan of Dynamo Laboratory.

current machines, two 30-kw direct-current machines and one 7-kw 110-40-volt motor-generator. The direct-current dynamo laboratory contains various types of closed and open-coil constant-current machines; simple, shunt and compound-wound bipolar and multipolar machines, of English, Canadian and American manufatcure. Among these are two 16 and one 10-light arc dynamos, a 15-hp street railway motor and a large number of motors of capacities from 15 horse-power down to 1-20 horse-power.

In the alternating-current dynamo laboratory there are representatives of single, two and three-phase generators and rotary converters, single-phase and induction motors in sizes from 20 kilowatts to 1-5 horse-power. Among the alternating-current machines worthy of note are a General Electric revolving field 1-2-3-phase alternator provided with pole shoes of different shape to obtain different form: a S. K. C. 1-2-3-phase inductor machine provided with different shape inductor lugs; a 12½-kw Mordey machine with the armature coils arranged to be set at different angles, and a 2-3-phase induction motor arranged as a frequency changer. All of the machines in the two dynamo laboratories are driven by direct-current motors.

is utilized not only for calibrating something like 200 instruments in daily use in the different electrical laboratories, but arrangements have been made with a number of Canadian electrical companies by which their instruments are periodically checked against McGill standards.

In the high-tension laboratory there are four 10-kw 200-50,000-volt Westinghouse transformers; a 15,000-150,000-volt Kelvin electrostatic voltmeter and a complete equipment otherwise for high-voltage testing.

The research laboratory is equipped with small alternating and direct-current alternators and motors and constant-current and constant-voltage transformers of different types and sizes. Tables for special work are supplied with current of different kinds and at any desired voltage.

For individual student work there is a large collection of measuring instruments, the extent of which may be judged from the fact that it includes no less than sixty Weston ammeters, voltmeters and wattmeters; twenty Thomson ammeters, voltmeters and wattmeters, and twenty-five others of miscellaneous types. There are three sets

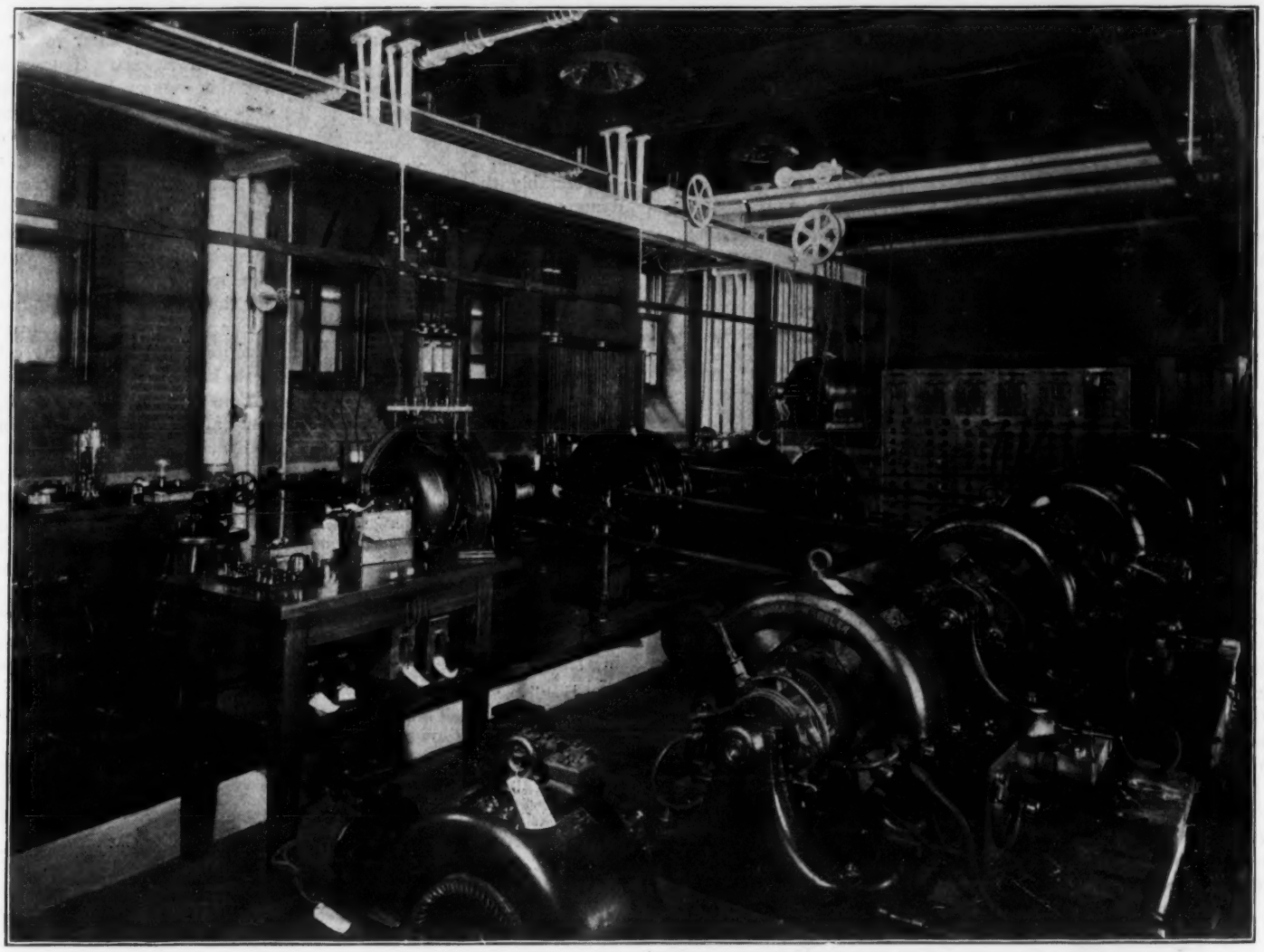


FIG. 10.—ALTERNATING CURRENT LABORATORY.

Among the laboratory devices are means for obtaining alternating-current waves by a modification of the Duncan method, and for obtaining leakage coefficient by means of the Dudell oscillograph.

The standardizing laboratory is equipped with means for measuring alternating and direct-current e. m. fs. to 3000 volts with all the accuracy obtainable with modern apparatus. Four Kelvin balances ranging to 600 amperes are provided, and an Elliott potentiometer with fixed resistance giving a range of 15,000 amperes. Among other instruments are Kelvin static and multicellular voltmeters, standard Weston ammeters and voltmeters, and instruments of various kinds made by Crompton, Nalder and Elliott Bros. Carhart-Clark, Muirheads and Hibbert standard cells are represented. Among other apparatus are a Ewing permeability bridge, a Ewing hysteresis meter, a continuously variable voltage transformer for alternating current voltage calibration, a 110-10-volt motor-generator. This laboratory of 64 cells each Type E chloride accumulators, and 100 cells of Type B for voltmeter calibration.

In the high-tension laboratory investigations are now being conducted on the conditions affecting the striking distance in air and other media; the effect of wave form on striking distance; the effect of continued dielectric stress on the insulating properties of various compounds, and the conduction between electrodes of different forms in air and other media at high alternating and direct current pressures.

In the dynamo laboratories a study is being made of the special conditions affecting the successful parallel operation of synchronous converters; on the wave form of alternators of different types as affected by character and amount of load, and on the effect of wave form on the operation of induction machinery.

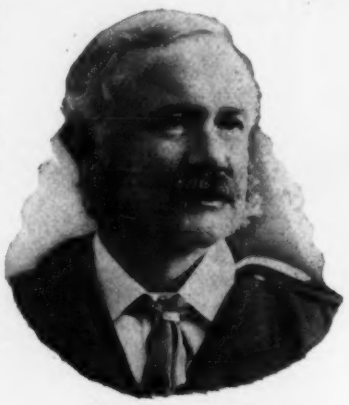
Third-year men devote themselves largely to direct-current work,

fourth-year men to alternating-current work, and graduate men to special investigation. The first two years of the electrical course is devoted mainly to a training in physics, mathematics, chemistry, drawing and design, the last two years being reserved for electrical work proper.

No account of the McGill engineering laboratory would be complete without reference to the able men who have been directly instrumental in placing it on its present high plane—Sir William C McDonald, Dean Bovey and Prof. R. B. Owens. Owing to his prominence in the United States as an engineer and educator, the last is well known to our readers. Prof. Owens' appointment to the University was in itself a flattering recognition of his merits, and his excellent work there is revealed in the above account of the laboratory he has created under the direction of Dean Bovey.

SIR WM. C. MCDONALD.

Sir William C. McDonald, who, upon the appointment of Prof. R. B. Owens to the chair of electrical engineering at McGill, generously took upon himself the cost of re-equipping the electrical laboratories, and to whom this University owes its facilities for teaching and research in that department, as in other departments of science, is a wealthy citizen of Montreal. He is the youngest son of the late Hon. Donald McDonald, at one time president of the Legislative Council of Prince Edward Island, and is a grandson of Capt. John McDonald, eighth chief of the Clan McDonald, of Glenaladale, who founded the Scotch settlements of Tracadie, Scotchfort, Glenfinnin and Fort Augustus, P. E. I. He was born at Glenaladale, Tracadie, P. E. I., 1833, and left Prince Edward Island in 1854, removing to Montreal. He now owns the largest tobacco factory in Canada. His benefactions to the University aggregate at least $3,000,000. Nor is his generosity extended only to the University. He has lately, at his own private cost, set up model training schools in the principal centres of Canada, with a view to inducing the Provincial authorities to include manual training in the curriculum of the elementary schools. In recognition of his services and of his great gifts to the cause of education in Canada, he was the recipient in 1898 of the honor of knighthood.



PROF. H. T. BOVEY.

Prof. Bovey was born in Devonshire, England, March 7, 1852. His primary education was received at a private school, after which he entered Cambridge University, where he competed for and obtained an open scholarship. On graduation he took a high place in the mathematical tripos, and shortly afterwards was made a fellow of Queens College. Adopting the profession of a civil engineer, he joined the staff of the Mersey Docks & Harbor Works, and was in a short time appointed as an assistant engineer on this work.

PROF. R. B. OWENS.

In 1877 he came to Canada in his appointment as Professor of Civil Engineering and Applied Mechanics in McGill University. At that time the engineering courses in the University were managed as a branch of the faculty of arts, and were without buildings or equipment. The following year, however, a department of applied science was constituted with Prof. Bovey as Dean, and to his management and advice the science department owes its splendid development. The magnificent engineering buildings were planned and equipped by Dean Bovey, and the whole of the work carried out under his direct supervision.

Some of the Requisites of Modern Lighting Generator. Sets.*

BY H. G. REIST.

AT the Washington meeting of the A. S. M. E. in May, 1899, a very interesting and stirring paper was read by Mr. Stanwood on "Standards for Direct-Connected Generator Sets." So far as I know, this was the first time that the desirability of the engine and dynamo builders getting together and trying to make their designs interchangeable as far as practicable, was brought before the public. Its importance was at once realized and action taken towards improving matters by the appointment of a committee and inviting other organizations interested to co-operate. I understand these committees are taking up the standardization of speeds of engines as well as the proportioning of certain parts that affect the two pieces of machinery, such as dimensions of base and the diameters of the engine shafts.

It will not be possible to fix absolute speeds for engines used for directly driving alternating current machines, because currents of various frequencies are used for different classes of work, and dynamos must be built with an even number of poles, or, better yet, with a number of poles that is divisible by four. The ordinary frequencies used are 25, 40 and 60 cycles per second in this country, but in Europe the usual frequency is 50 cycles. To illustrate the variation in speed necessary for the various frequencies: For 60 and 40 cycles, a speed of 220 r. p. m. may be used, but for 25 cycles, the speed must be 187 or 214—preferably the former. Similarly we can make 60 and 40-cycle dynamos to operate at 100 r. p. m., but the 25-cycle machines must be driven at 94 or at 107. In working over a list of speeds for the various frequencies it will be found that a mean speed may be selected which in no case need be much departed from, so that it seems perfectly practicable to select a range of speeds for the various sizes of engines at which they may be run without any changes except an adjustment of the governor. Then, by a careful selection of sizes best ranged in geometric progression, it will be feasible to keep down the number of machines very greatly, leading to duplication, thus to the practicability of making special tools for more of the parts and also to stocking parts, and the ability of making quick deliveries.

We have given considerable thought to the selection of a range of sizes and have come to the conclusion that if the units were so spaced that each one has a 50 per cent increase over the one below it, there will be a sufficiently large number of machines to meet all ordinary conditions. This conclusion is also sustained by having had a practical application in lines of generators and motors spaced about in this way, and it is a rarity that it becomes necessary to go to the expense of developing anything in between. This method of determining sizes will necessarily make some of the machines on the list with odd ratings, but this will occur in any case—in many instances with either the engine or generator, since the one is rated in horse-power and the other in kilowatts.

A list of sizes of generators and speeds that has been proposed is shown in the following table:

Kilowatts.	Speed.	Kilowatts.	Speed.
60	250—276	450	125—133
90	240—257	450	94—100
133	214—225	675	133—138
200	187—200	675	120—125
200	150—150	675	90— 94
200	107—112.5	1000	120—125
300	150—150	1000	82— 85.5
300	125—138	1500	107—112.5
300	106—109	1500	75— 80
450	150—150		

The variation in speed given allows the same engine to drive generators for the three frequencies standard in this country. It will be noted that with very few exceptions, the total variation in speed is less than 10 per cent—in most cases being only about 2½ per cent from a mean speed. For each capacity given, except the smaller ones, several speeds are proposed to accommodate the different types of engines.

In all reciprocating engines there is an intermittent speed, due to the crank, the speed gradually increasing during a stroke until such a time when the power applied is less than the mean power absorbed, after which the speed gradually decreases until steam is again admitted. It will thus be seen that with a single crank engine, there is during each stroke, i. e., each half revolution, a period of increasing

*A paper read Dec. 4 at the annual meeting of the Engine Builders' Association of the United States.

speed—then, again, one of decreasing. With two cranks at 90 degs. there will be four such periods during each half turn. With cranks set 120 degs. apart there will of course, be six such periods. The amount of fluctuation in speed is dependent on the number of cranks, the weight of the reciprocating parts, the length of the connecting rod, the proportioning and adjustment of the valves and the weight of the flywheel. It is desirable to keep the variation within certain limits on account of the parallel operation of generators, but more particularly to assure the satisfactory operation of synchronous apparatus such as synchronous motors and rotary converters from such circuits.

When two generators are running in multiple, their mean speed will be the same, but as the speed is variable as mentioned, there is an instant during which one of the generators runs a little faster than the other. It will be seen that its potential wave will then get ahead of the wave produced by the other machine, and in consequence current will flow into the second machine and tend to drive it as a motor. A little later, when the engines are a little further along in the turn, the conditions will be reversed. This will produce cross currents between the machines which should be avoided. It might be prevented with duplicate sets, if the engines were synchronized, i. e., if they were run with the cranks of the machines in the same relative position. The angular velocity of one engine is then the same as that of the other engine at all times. But this is not a practical method of operation. This fluctuation is also liable to make synchronously-driven electrical machinery drop out of step. In practice, the allowable variation is usually given in displacement in degrees of any point on the rotating mass from what it would have if the motion was perfectly uniform, which gives a value that is independent of the number of cranks of the engine. Steam engines intended for direct connection to dynamos should not have an angular deviation in degrees of more than 2½ degs. to 3 degs. of phase; or, dividing the number by one-half of the number of poles of the generator to be driven, will give the allowable angular deviation in terms of degrees of the rotating mass. Thus, a 40-cycle machine should be driven by an engine whose motion is so uniform that a point on the rotating mass will not vary more than $\frac{2.5}{20} = \frac{1}{8}$ of one degree from the position it would have if the motion was perfectly uniform.

In order to obtain this result, it is necessary to have a flywheel of sufficient size, the weight of which depends on many things relative to the proportioning of the engine, and cannot be given except for special cases. It is desirable for many reasons to so design the engine as to get along with as small a flywheel as possible. If the weight is too great, serious trouble may be experienced in trying to operate the machines in multiple, because the governor cannot control quickly enough and the machines will be sure to hunt. The connecting rods should not be made too short, as this will distribute the load unequally so as to require a heavier wheel than otherwise, to keep within assigned limits of variation.

From various sources I have obtained data regarding the flywheel effect necessary to meet the above degree of regulation and think a safe figure for well proportioned engines is expressed by the formula:

$$\text{Weight} = \frac{C \times KW \times 100^3 \times 5000^2}{R.P.M.^2 \text{ (Speed in ft. at rad. of gyration)}^2}$$

in which C is a constant, having the following values:

	Horizontal single crank.	Horizontal cross comp.	Vertical cross comp.
25 cycles	65	40	60
40 cycles	104	64	96
60 cycles	156	96	144

I believe the values in this table are very safe and it will probably be possible to meet the given conditions with a wheel considerably lighter in weight.

It would naturally be expected that a three-crank engine with cranks placed 120 degs. apart, would require a lighter flywheel than one with two 90 deg. cranks, but in working out the forces of compound three-cylinder engines, it has been found that the weight of the reciprocating parts and the distribution of the load between the various cylinders predominates, so that no appreciable better results are obtained than from a two-crank cross-compound engine.

Ever since alternating current machines have been built, parallel operation has been discussed. At first it was tried with very great caution, but it is at present the usual method of operation, and experience has taught us that any two alternators of the same frequency and potential will operate in multiple satisfactorily, if they are allowed to do so by the prime motors. No trouble is experienced in operating machines in multiple when they are driven by water wheels. There are also many installations of steam-driven alternators (ofttimes of different types)—both belted and direct coupled—operating satisfactorily in multiple.

The principal trouble experienced in the parallel operation of alternators is due to the variation of the speeds of the machines with reference to each other, producing oscillations in the relative motions of the two alternators. This produces cross currents and variations in the cut-off of the engines. The engines will then race or hunt.

In some cases the amplitude of these oscillations is limited in extent, while in others, their force is liable to accelerate with more or less rapidity until the machines drop out of step. In some cases the machines may run in parallel for a considerable period of time, when, by some change of conditions, oscillations will begin which may throw the machines out of step in a few seconds. The power to produce these impulses or oscillations comes naturally from the steam, and they are caused by the intermittent action of the engine governors, which in their efforts to adjust themselves to compensate for the speed variation cause a periodic delivery of steam. The delivery of steam by jerks keeps up the oscillation in the same manner as the pendulum of a clock is kept going. This trouble can be stopped in most cases by the use of a dash-pot to dampen the action of the governor. The ordinary dash-pot is a device well known to engine builders, and was used to prevent racing in engines long before the parallel operation of alternators was practiced. It is possible by its means to run the engine with closer regulation of speed between no load and full load than otherwise, although the governor will not act so quickly—so that there will momentarily be a greater variation of speed than if the dash-pot was not used. But experiments have shown that the dampening effect need not be so great in ordinary cases as to impair the speed control seriously. The frequency of this variation seems to be affected by many conditions, such as the flywheel effect of the rotating masses on the engines, the period of the engine impulses, the synchronizing power of the dynamo, and probably by the flywheel effect of any synchronous machinery driven by the current from the dynamos.

The degree of retardation of the governors required for proper parallel operation must depend upon the combination of these effects, and is, consequently, difficult to predetermine. It will, therefore, generally be advisable to adjust the governors by experiment, and for this purpose engines should be fitted with adjustable dash-pots of ample size so that the governors may be retarded to any desired degree. The amount of retardation needed may be judged from the following example.

Two 1000-kw 72-pole machines running at 100 r. p. m., from horizontal engines, with cranks quartering, were found to oscillate badly at the rate of about 50 beats per minute when in parallel. The addition of dash-pots entirely cured the trouble. After the addition of these dash-pots, when full load was suddenly thrown on, a period of about 7 seconds elapsed before the governor reached its final load position. During this period the speed fell 3 per cent and then increased again 2½ per cent, the full load speed being ½ per cent less than the no load speed. This arrangement gave good parallel operation, and was adopted.

There are, however, cases where a simple retarding device is not sufficient without seriously affecting the governor of the engine. A special form of dash-pot has been devised for such cases, being so constructed that it is almost rigid for very sudden changes, but if there is pressure for an appreciable time, the length of which may be varied by adjustment, the dash-pot allows an easy and rapid motion. Such dash-pots have been applied in cases where the conditions were such as to produce very serious trouble without them, and have produced absolute stability.

Engines that are directly coupled to alternators that are to be run in parallel, should be provided with means by which the speed may be adjusted within a small range without throttling while the engine is running. Such a device is very useful in bringing the machines together, while throwing them into parallel, when one machine is loaded and the other is idle. Without this, it is necessary to throttle the steam for the engine without load to bring it to the speed of the loaded machine. This device is also very useful to divide the load between the machines, since however carefully they may be adjusted, high temperatures or some other local conditions may throw them slightly out of adjustment.

Railway Telephony.

It is understood that the Northern Pacific Railway proposes to install a telephone service for handling its freight traffic.

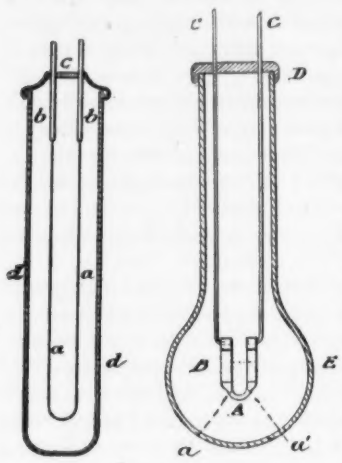
Incandescent Lamp Development to the Year 1880—III.

By Edwin W. Hammer.

(*Concluded.*)

LANE-FOX, 1878-9.

To St. George Lane-Fox, an English investigator, should be accorded the distinction of having appreciated earlier than any one else, with the probable exception of Mr. Edison, the necessity of high resistance and small radiating surface in incandescent lamps, and also of the desirability of using such lamps in multiple-arc. To him were issued three English patents and one provisional specification relating to his lamp investigations. The first of these, No. 3988, of 1878, is dated Oct. 9, 1878, at which time the provisional specification was filed; the complete specification was not filed, and therefore not published, until April 9, 1879. This patent has considerable to say regarding the theoretical considerations mentioned above as desirable features of an incandescent lamp, but the patent does not show suitable lamp construction for realizing them. He proposes to employ a depending hairpin loop of fine wire made of an alloy of platinum and iridium which might or might not be placed in a chamber containing nitrogen gas. While such a wire would have high resistance relative to some previous forms of lamps, it would not furnish the burner necessary to meet the requirements Lane-Fox already recognized as essential. Fig. 9, reproduced from the patent, shows this first lamp, in which *a* is the platinum-iridium burner.



FIGS. 9 AND 10.—LANE-FOX LAMPS.

The next step in the development of the Lane-Fox theories into a concrete structure will be found in his patent No. 4043, of 1878. In this patent he makes no advance in his lamp construction, but says that the covering of the surface of the wires of the burners with finely divided asbestos, fire clay, lime, magnesia or steatite, or some vitreous material, or a mixture of the vitreous material with some of the other materials, will permit of a greater radiation of luminous rays than will a polished wire surface at the same temperature, and that the economical operation of the lamp is thus increased; he also proposes the use of asbestos or other suitable non-conducting refractory material saturated or impregnated with some conducting refractory material such as carbon or iridium. Fig. 10, taken from this patent, shows an electric lamp in which the luminous surface or "bridge" is made of asbestos or similar non-conducting material saturated or impregnated with some refractory conducting material such as carbon or iridium. *A* is the "bridge" whose luminous portion *a* to a^1 is of higher resistance than the rest. The flask *E* may be hermetically sealed and filled with nitrogen gas.

In the provisional specification of the Lane-Fox patent No. 4626, of 1878, the lamp is not illustrated in the drawings, and he makes use of a "sheet of platinized or iridized or carbonized asbestos or other suitable material supported between two conducting terminals of platinum or other suitable material * * * and enclose the whole in a glass or other suitable transparent vessel or cover through which the platinum supports are fused. * * * The glass vessel may be made in any way by which it can be readily opened when desired and be again hermetically sealed." After exhaustion of the tube some gas may be admitted into it "if desired."

The complete specification of this patent discards the devices of the provisional specification and goes back to the preferred burner of patent No. 4043, of 1878, and to the platinum-iridium wire.

The last Lane-Fox patent, No. 1122, of 1879, contains but a provisional specification without drawings. It deals with the method of manufacturing the luminous "bridge" which is to be a mixture of conducting and non-conducting material, as, for example, plumbago for the conducting material and earthy matter for the non-conducting material. These substances are mixed in proportions to give the required specific resistance and are then compacted under powerful pressure. A film of carbon is then to be deposited upon this bridge by immersing it in hydrocarbon and passing an electric current through it. He proposes to maintain the temperature the same throughout the length of the bridge by making it narrower at the ends than in the middle—an impracticable measure.

It cannot be doubted for a moment that Mr. Lane-Fox had very clear and advanced opinions regarding the essentials of a practical system of electric lighting, but in his choice of means for realizing these essentials he was unfortunate and clearly unsuccessful.

THOS. A. EDISON, 1877-9.

From what appears above it may be seen that none of the inventors we have considered had, with the exception of Lane-Fox, appreciated the necessity of high resistance in an incandescent lamp burner, and that none of them, Lane-Fox included, had produced a high resistance lamp suitable for multiple-arc distribution.

Fontaine had demonstrated to the satisfaction of the scientific world that the subdivision of the electric light was impossible of attainment and that disintegration of carbon, when incandescent, ruled it out of consideration for small burners. Fontaine showed that if one lamp, connected with a battery, gave a light of 50 carcel burners, two such lamps connected in the same circuit and supplied with the same current would not give 25 carcels each, or a total of 50 carcels, but would give a total very much less than 50, and that each additional lamp placed in the circuit would reduce the total light emitted by all the lamps in an entirely disproportionate ratio, until a point would be reached where none of the lamps would give any light. Of course, the underlying fallacy was to be found in his assumption, and that of the scientific world, that the smaller light should be produced by passing a smaller current through the same lamp.

When, in October, 1878, great publicity was given to the announcement that Mr. Edison had solved the problem of subdivision (by his platinum lamp) there was a panic in gas shares and managers of gas interests sought help from men of science to show the impossibility of the claim. In response to this appeal Mr. W. H. Preece demonstrated mathematically that "the subdivision of the light is an absolute *ignis fatuus*" (*The Telegraphic Journal*, Feb. 15, 1879, Vol. VII, pp. 59-60); Prof. S. P. Thompson, in a lecture delivered Nov. 8, 1878 (see *Engineering*, Vol. XXVI, pp. 499-500), said: "This I can tell you, as the result of all experience, that any system of electric lighting depending on incandescence will utterly fail from an economic point of view, and will be the more uneconomical the more the light is subdivided." Numerous similar statements might be quoted, showing the universal misconception of the facts, as, for instance, the editorial in *Engineer* (Feb. 14, 1879): "If the current can be successfully divided among dozens of such lamps (Edison platinum lamps), then may gas makers quake, but nothing of the kind can be done."

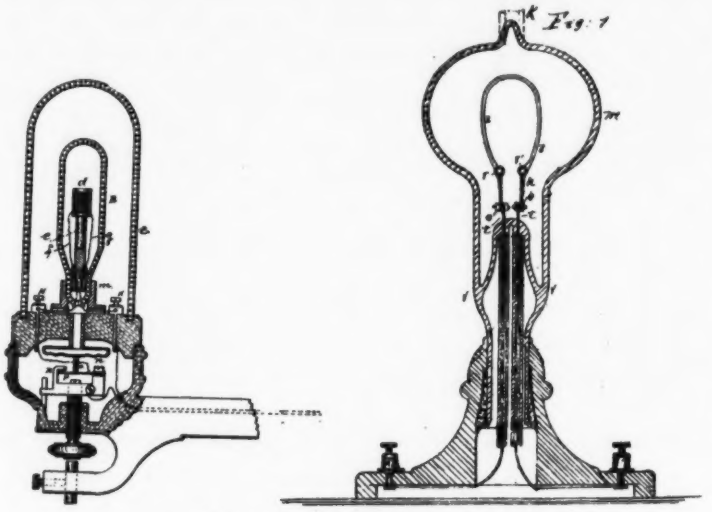
In the fall of 1877 Edison tested the lighting capacity of strips cut from sheets of carbonized paper, first in the open air and afterwards in the glass globe of an air-pump. Of course, the strips tried in the air were immediately oxidized and destroyed, while those in the globe lasted but a few minutes. The rapid oxidation of these carbon burners caused Mr. Edison to turn his attention to materials not subject to oxidation. In one of his note books, under date of Nov. 1, 1877, he says: "Have tried boron, ruthinium, chromium and the almost infusible metals for separators in my electric light device. Boron is of very high resistance and would do if arranged thus." (Here follows a sketch showing multiple-arc arrangement.) "Silicon, on the other hand, is of very low resistance, and would have to be arranged thus." (Here follows a sketch showing series arrangement of lamps.) Undoubtedly, even at this early period, Edison appreciated the characteristics, so far as resistance was concerned, of lamps designed for multiple-arc distribution.

About the beginning of the year 1878 these experiments were laid aside because of the excitement incident to the discovery and exhibition of the Phonograph, and during the summer, being much run down in health, he visited the Pacific Coast, returning in August, when he once more took up the lighting experiments. Carbon was again tried in various forms, but it was again demonstrated that it was too easily oxidized and destroyed to be available under the conditions he was yet able to obtain. The above facts and many others of value, were told in narratives of unique interest by Edison and his principal assistants, Messrs. Chas. Batchelor and Francis R. Upton, in interference proceedings held in 1881 and to be found in Vol. V of the Filament Record. Regarding the 1878 experiments, Mr. Edison says: "When we made the carbon in such a form as to have a small mass and high resistance to suit our purposes, it would last but several minutes. We then laid these experiments aside, and went on

with platinum, to endeavor to obtain a lamp of high resistance and small radiating surface. * * * The great point we desired was a lamp of high resistance and small radiating surface, and it did not matter very much whether it was of carbon or of platinum." The final outcome of these experiments with platinum is to be found in patent No. 227,229, issued May 4, 1880, and applied for April 21, 1879. Fig. 11, herewith, is taken from this patent and shows the perfected platinum lamp. It consists of an all-glass globe *B*, sealed upon itself at all points and containing an incandescing burner formed of a great length (about 30 feet) of very fine platinum wire, coated with magnesia oxide and wound as a spool upon a cylinder of lime, to reduce the effective radiating surface. This inner globe is connected to a thermal regulator *n* controlled by the expansion and contraction of the air between the inner and outer chambers, due to the heat from the burner. This patent also describes the method of treatment by which Edison produced a consolidation of the molecules of the platinum with a consequent raising of its fusing point and an increase of its light-giving capacity from 4 candles to 25 candles.

Edison's deposition tells of further progress as follows:

"But when, in the course of our attempts to attain the same objects by means of incandescent platinum, we had procured a Sprengel mercury-pump and ascertained that we could get exceedingly high vacuo, it occurred to me that, perhaps, a filament of carbon could be



FIGS. 11 AND 12.—EDISON LAMPS.

made to stand in the sealed glass vessels which we were using, exhausted to a high vacuum, and in October (21), 1879, we made lamps of paper carbon and carbons of common sewing thread placed in a receiver made entirely of glass, with the wires sealed therein by fusion, and the whole exhausted by a Sprengel mercury-pump to nearly one-millionth of an atmosphere, and these filaments of carbon, although excessively fragile, owing to their small mass, had a smaller radiating surface and higher resistance than we had hoped; we had reached the condition where, notwithstanding the carbons were small in mass and filamentary, they were stable."

Mr. Edison also testified:

"I mean to say that I discovered the fact that carbon would stand high temperatures even when very attenuated, in a high vacuum, without the phenomena of disintegration which took place in all the previous attempts that I know of, when trying to use carbon to make an incandescent lamp."

He was asked:

"Was that discovery the result of that experiment in which you used a thread in a highly-exhausted all-glass globe?"

He answered:

"Yes, sir; it was in that particular lamp that I discovered this all-important fact that something which was expected to take place did not take place, and this discovery permitted the use of fine filaments and carbon of high specific resistance, and made incandescent lighting, as we know it, commercially practicable."

This discovery was embodied in patent No. 223,898, and has been passed upon favorably by the courts. Judge Wallace said in his decision on this patent in the filament case: "It was a remarkable discovery that an attenuated thread of carbon would possess all the long-sought qualities of a practical burner when maintained in a perfect vacuum." He also said Edison "was the first to make a carbon of materials and by a process which was especially designed to impart high specific resistance to it; the first to make a carbon in the special form for the special purpose of imparting to it high total resistance; and the first to combine such a burner with the necessary adjuncts of lamp construction to prevent its disintegration and give it sufficiently long life. By doing these things he made a lamp which was practically operative and successful, the embryo of the best lamps now in commercial use, and but for which the subdivision of the electric light by incandescence would still be nothing but the *ignis fatuus* which it was proclaimed to be in 1879." These sentiments were also proclaimed by the judges in the case on appeal and in other litigations in this country and in England.

In 1881, during the discussion which followed the reading of a paper before the Royal United Institution by Mr. Crompton, the English electrical engineer, Mr. Lane-Fox paid the following tribute to Mr. Edison (see the *Journal* of that Institution, Jan. 26, 1881, Vol. XXV, London, 1882):

"I think great credit is due to him for having stated from the very first that it was possible to introduce a system of electric light that could be so distributed and divided as to be available for household purposes. I think Mr. Edison was the first, and not Mr. Swan, to produce a practically useful lamp on the incandescent principle with a filament of carbon in a vacuum. Mr. Edison's researches, too, in respect to the presence of occluded gases in metal and other substances, are exceedingly interesting and very sound and scientific in the manner he has carried them out. I think he has rendered very great service not only to the future of electric lighting, but also to science by his investigations, and for this proper credit should be given him, more especially as in the future he will be able to show, and I have no doubt, will show, that he was the first to succeed, and I think it is as well to recognize it at once. I say this entirely disinterestedly, because it is very much to my disadvantage that Mr. Edison should be first, as I have also claims in this direction."

This fundamental invention of the filamentary lamp was followed by many others, in rapid succession, resulting in the early perfection of the lamp. The paper-carbon horseshoe filament lamps (shown in Fig. 12, taken from Edison's paper-carbon patent application) were the first placed in an actual commercial installation and the bamboo filament lamp soon followed. The various details of the "Edison system" were soon developed, and it was not long before Edison's conception of an incandescent lighting plant in direct competition with gas was realized.

Where the Calcium Carbide Goes.

In view of the large production of calcium carbide, the question is often raised as to the use made of it. According to advices from Stuttgart, the German acetylene gas industry has so developed as to be a question of great economic importance, having a direct influence upon a great American industry. Germany annually pays the United States $25,000,000 for petroleum used for purposes of light and fuel. As a direct result, the American manufacturers of petroleum implements, novelty lamps, stoves, etc., find in Germany a large market. According to the British Consul in Stuttgart, the growth of the acetylene gas industry will shortly reduce this trade in petroleum to a very small item.

In his report to London he points out that there are at least 200,000 jets of acetylene gas in use in the country, and it is impossible to predict the result of the competition between it and its rival illuminants. Probably petroleum will suffer most; coal gas will be superseded to a great extent, especially in lighting small towns, but electricity will not be appreciably affected, and he concludes: "No other branch of industry can point to such a large and steady increase in the number of patents, showing that it has encouraged great fertility of invention. Besides producing it at home, German capital has gone abroad to produce carbide, especially to Norway and Switzerland. One of the greatest successes of the industry has been its application to the lighting of railway carriages on German Government lines. During the current year the consumption of carbide in Germany is estimated at 17,000 tons, equal in illuminating power to about 7,000,000 gallons of petroleum. Thirty-two small towns, with populations up to 5,000, are lighted by acetylene, and many more contemplate its adoption, and the progress of the system of lighting," says the Consul, "is another striking instance of the manner in which the magnificent system of technical education has prepared the way for the introduction of new scientific achievements."

The Induction Motor—VII.

By B. A. BEHREND.

CALCULATION OF A SINGLE-PHASE CURRENT MOTOR.

THE three-phase current motor, the design of which was given in chapter V, is reproduced in Fig. 32. We shall now proceed to examine the behavior of this motor if running as a single-phase motor. For simplicity's sake we shall retain the winding, and investigate what voltage is most suitable for it. The motor, as will be remembered, has 16 poles, and is to work again at 60 p. p. s.

Field Winding.—128 slots, 10 conductors in each slot; diameter of wire, 0.229″; resistance hot, 0.28 ohm.

Armature Winding.—240 slots, 2 conductors in each slot; wound

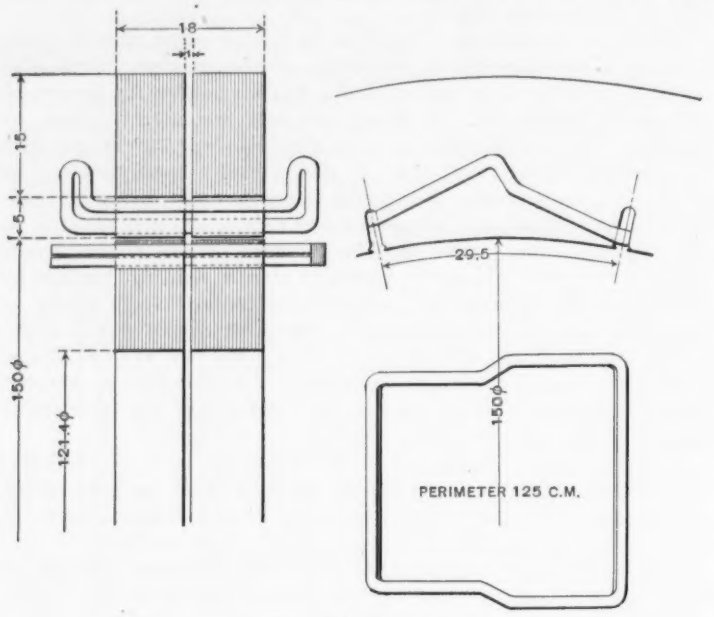


FIG. 32.

in three phases in star connection; resistance of each phase, 0.016 ohm.

E. M. F.—According to (18) we have:

$$(18)\ldots\ldots N = \frac{2}{3}\, b.\, t.\, B.$$

$b = 17$ cm.
$t = 29.5$ cm.
$B = 5600$.

The diminution of the air-gap through the open slots is taken into account by reckoning only 85 per cent of the surface of the air-gap. Thus, we find:

$$N = 1.58 \,.\, 10^6 \text{ c. g. s.}$$

In the three-phase current motor we had:

$$N_3 = 1 \,.\, 42 \,.\, 10^6 \text{ c. g. s.}$$

We insert $N = 1.58 \,.\, 10^6$ in formula (19) and get

$$100 \,.\, e = 1.85 \,.\, \sim \,.\, z \,.\, N \,.\, 10^{-6} = 2250 \text{ volts.}$$

Therefore, the terminal voltage should be equal to 2250 volts.

Hysteresis.—The loss through hysteresis and eddy currents amounts to 1150 watts, of which 570 is dissipated in the teeth, and 580 in the iron ring.

Magnetizing Current.—From (17) follows

$$i_m = \frac{B \,.\, 1.6\, \triangle}{n\, \sqrt{2}}$$

We insert the following values:

$B = 5600$ c. g. s.
$\triangle = 0.15$ cm.
$n = 80$.

and find

$$i_m = 12 \text{ amperes.}$$

Leakage.—The leakage coefficient is 0.061 for the iron frame.

Idle Current.—We have according to (13):

$$(13)\ldots\ldots \frac{i_m}{i_0} = \frac{1 + 2\,\sigma}{2 + 2\,\sigma} = \frac{1 + 0.122}{2 + 0.122}$$

$$i_0 = \frac{12}{0.576}$$

$$i_0 = 20.8 \text{ amperes.}$$

Friction.—Loss through friction and air resistance, 2150 watts.

We can now draw our standard diagram. This has been done in Fig. 33. The ordinates measured between the full line curve and the basis of the semi-circle measure the output of the motor for the armature with small resistance. The ordinates between the broken line curve and the basis of the semi-circle measure the output of the motor for the squirrel cage armature.

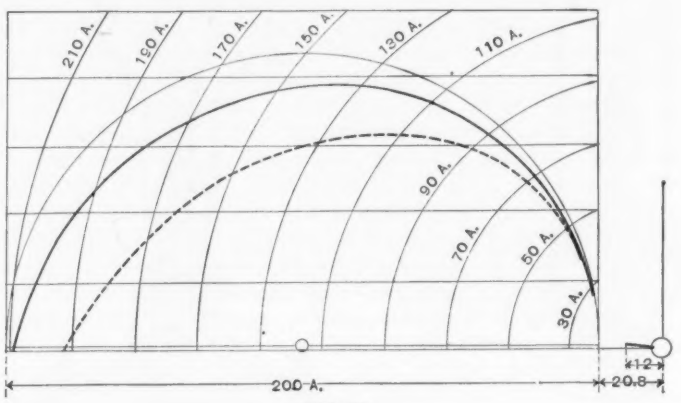


FIG. 33.

From this diagram the following table has been compiled.

A few words may be said as to the calculation of the slip, which is here expressed in p. p. s., and the calculation of the torque.

Data of 180 h. p. Single-phase Current Motor.

2250 volts, 60 p. p. s., 450 r. p. m.

Amperes, field.	Amperes, armature.	Loss in field.	Loss in armature.	Watts, input.	Watts, output.	Torque in synchronous watts.	Slip in p. p. s.	Efficiency. η	Power factor, $\cos\phi$	Loss in squirrel cage armature.	Watts, output.	Slip in p. p. s.	Torque in synchronous watts.	Efficiency.
30	66.6	500	212	43,900	39,888	....	.....	0.91	0.65	1270	38,830	59.1	39,500	0.885
50	135	1400	874	91,000	85,426	85,800	59.73	0.938	0.81	5250	81,050	58	84,000	0.89
70	195	2740	1820	129,000	121,140	....	.....	0.94	0.82	10,900	112,060	57.3	117,500	0.87
90	256	4530	3150	163,000	152,020	....	.....	0.933	0.805	18,900	136,270	56.3	145,000	0.837
110	316	6800	4800	190,000	175,100	177,500	59.2	0.922	0.768	28,800	151,100	55	165,000	0.795
130	375	9500	6750	209,000	189,450	193,000	59	0.907	0.715	40,500	155,700	53.5	175,000	0.745
150	436	12,600	9100	217,000	192,000	197,000	58.6	0.885	0.645	54,600	146,500	51.3	171,000	0.675
170	495	16,200	11,700	209,000	177,800	183,000	58.2	0.85	0.547	70,200	123,800	48	155,000	0.592
190	553	20,200	14,700	173,000	134,800	141,000	57.4	0.78	0.405	88,200	61,300	38.4	96,000	0.355
200	583	22,400	16,300	137,000	95,000	103,000	55.4	0.694	0.305	97,800	13,500	20.9	38,800	0.0985
208	608	24,200	17,700	83,000	37,800	45,900	49.5	0.455	0.177	....	....	..	....	....

Slip.—The slip can easily be found with the help of formula (15), as all quantities, with the exception of $\sim_2$, are known.

Torque.—The torque in synchronous watts is then obtained by multiplying the output in watts by the ratio of $\sim_1 \div \sim_2$.

Fig. 34 shows the field current and the output as a function of the energy consumed. The full line curves represent again the output of the armature with small resistance, while the broken line curve shows the output of the motor with squirrel cage armature, the resistance of which is six times as large as that of the armature with external starting resistance.

Fig. 35 shows the power factor and the efficiency for the two cases. The power factor is, of course, the same in either case. In the cal-

culation of the efficiency the load-losses have not been taken into account.

Finally, we have in Fig. 36 a graphic representation of the output

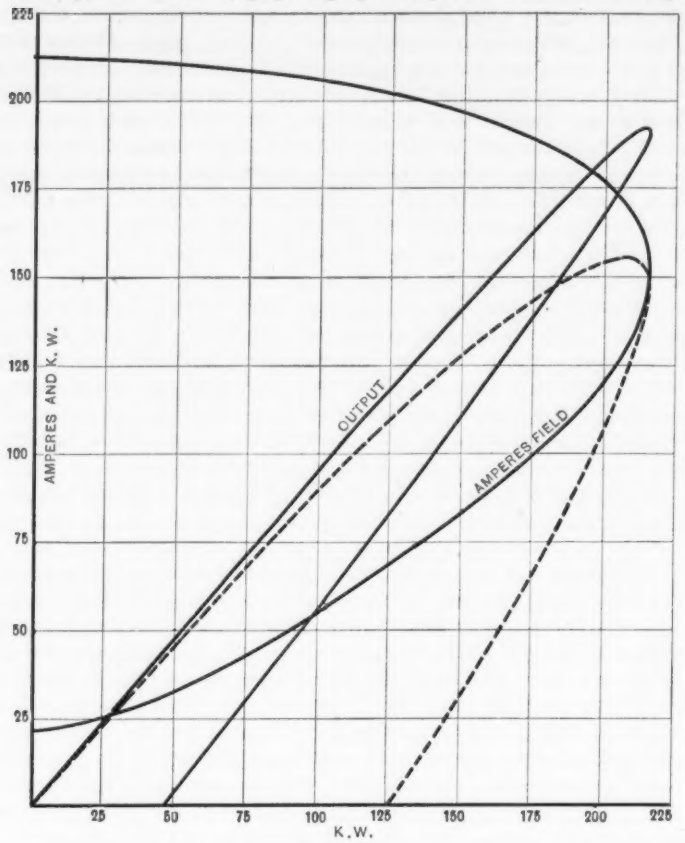


FIG. 34.

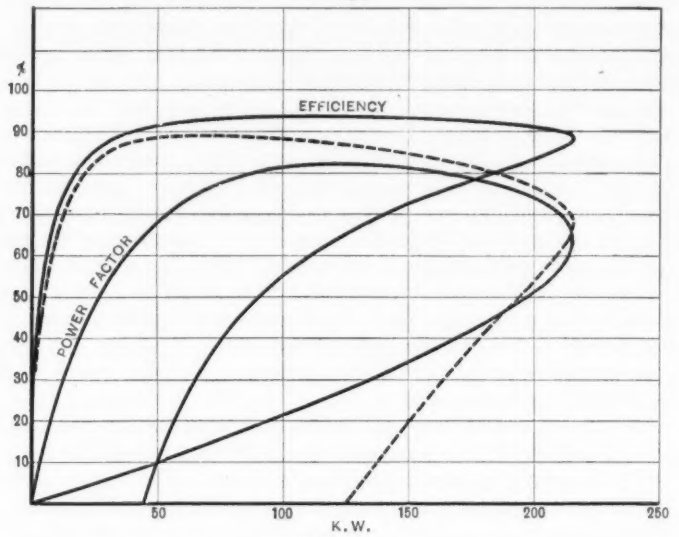


FIG. 35.

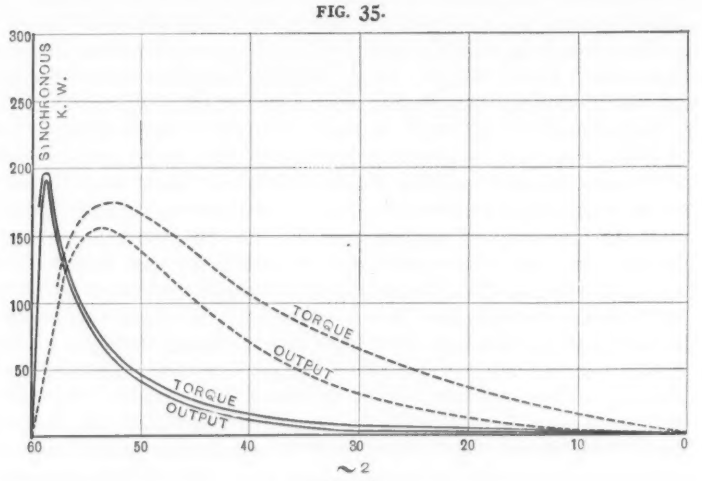


FIG. 36.

and the torque in watts as a function of the slip in p. p. s., or rather, of the number of revolutions of the armature expressed in p. p. s.

The broken line curves refer as usual to the squirrel cage armature. Little need be said about these curves. It is plain that for the armature with a small resistance the starting torque is still exceedingly small at $\sim_2 = 40$. Such a motor will never start well without extra resistance in the armature, whatever starting arrangement be made.

The effect of armature resistance consists in reducing the capacity

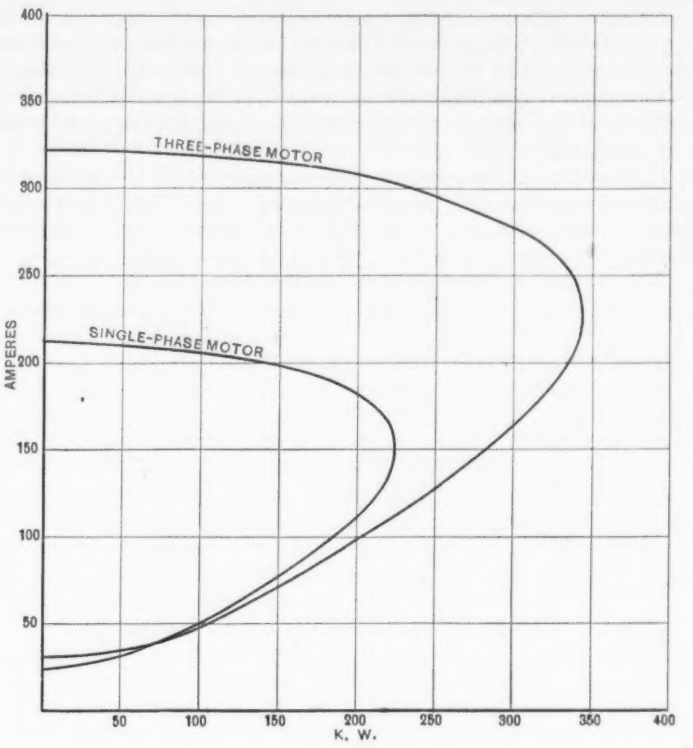


FIG. 37.

of the motor, and in shifting the maximum torque toward the starting point.

In designing the three-phase current motor, we had made the condition that the motor should start with a torque equal to twice the normal running torque. As all the starting devices that have been tried for single-phase motors are not worth very much, such a condition can, at present, not be fulfilled. We rate the motor, therefore, according to its most favorable efficiency and power factor. For 135 kilowatts we have an efficiency of 94 per cent and a power factor of 82 per cent, corresponding to an apparent efficiency of 77 per cent. The motor will safely yield 180 horse-power at 2250 volts.

It is instructive to compare the current in the three phases of the three-phase current motor reduced to the voltage of the single-phase current motor with the current in the single-phase motor. The three-phase motor took a magnetizing current of 12 amperes, corresponding to $12 \cdot 2000 \sqrt{3}$ volt-amperes. This divided by 2250 volts yields a magnetizing current equiv-

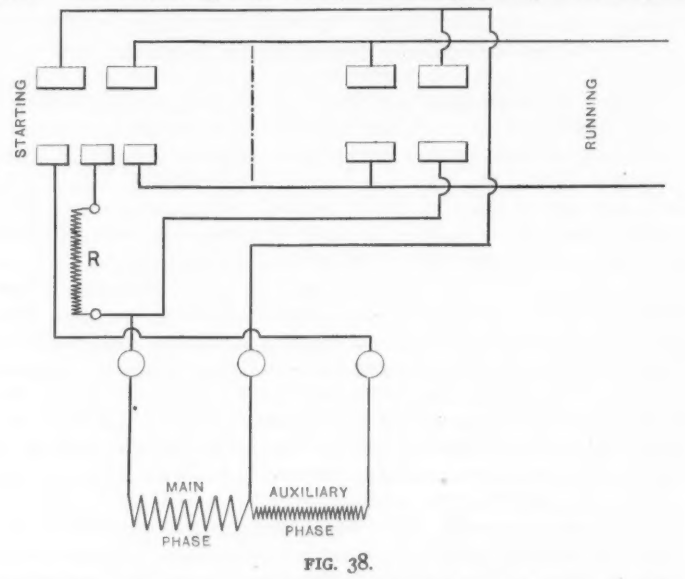


FIG. 38.

alent to 18.4 amperes. The leakage factor being 0.061, we can draw our standard diagram whence the curves in Fig. 37 are derived.

These curves clearly show that the maximum output of the single-phase current motor is only 0.65 the maximum output of the three-phase current motor.

STARTING ARRANGEMENTS.

A few words may fitly be added about the methods of starting single-phase motors. It has generally been found advantageous to use two-thirds of the pole-pitch for the main winding, and to leave the remaining third for the starting phase. The motor thus starts as an imperfect two-phase current motor. An external armature resistance is to be recommended for large sizes, say, for an output above 15 horse-power.

The starting phase receives generally either half the number of convolutions as the main phase, or twice as many. The latter method seems to be preferable. Figs. 38 and 39 show the switch used by the Oerlikon Engineering Works for their single-phase motors.

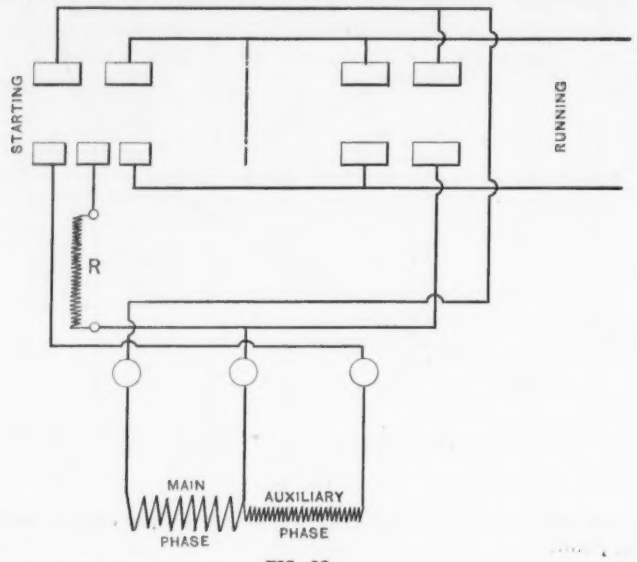


FIG. 39.

In Fig. 38 the resistance or condenser R is, at starting, in series with the main phase, the auxiliary phase being directly between the terminals.

In Fig. 39 the resistance R is in parallel with the auxiliary phase, which is in series with the main phase.

During the throwing-over of the switch from the starting position to the running position, the motor is temporarily disconnected from the mains.

In closing these essays on the design of induction motors I give expression to the hope that the treatment adopted in them will commend itself to the consideration of electrical engineers.

The last chapter we shall devote to a more general and broader treatment of the polar diagrams of the general alternating-current transformer.

The Telephone Situation in Colorado,

The telephone situation in Colorado presents many points of interest to a visitor from the Eastern States. The telephone business in Colorado is almost entirely in the hands of the Colorado Telephone Company (Bell), there being but three or four companies outside of this, and one of these is a toll line built by private parties in the western part of the State to connect with the Bell lines. The only town where two exchanges exist side by side is Trinidad.

Toll line business is a most important feature of telephony in Colorado, and there is no place in the Union where it is so popular, except possibly between New York and neighboring cities. This is due to a variety of causes, some of them local conditions, some of them matters of policy on the company's part. General Manager E. B. Field ascribes much of the company's success in the toll line field to its policy of never permitting its lines to become so crowded between any two points that customers have to do much waiting. When the average number of calls over a line exceeds 60 per day new circuits are immediately put in. Mr. Field finds that if lines have to handle more than this number per day, customers may have to wait and will get into the habit of telegraphing. This broad gauge policy of keeping in advance of the demand no doubt has much to do with the prosperity of the toll lines. There are, however, other reasons. Colorado is above all else a mining State and the volume of communication by telephone between the larger cities and the mining camps in the mountains is something surprising. Aside from purely commercial uses on business connected with the operation of the mines, the telephone toll lines play an important part in speculation. Mine owners as a class are great speculators, and are also free with their money, in common with other speculators. Most of them residing in Colorado Springs and Denver wish to talk frequently with Cripple Creek and other mining towns. In this connection it may be mentioned that the Colorado Springs mining exchange is second only to London in volume of business. Many of the mines in the Cripple Creek district with their enormous output of gold are owned by Colorado Springs men. From Colorado Springs to Cripple Creek there are 20 toll line circuits, besides some lines leased to private parties. More are going up. From Denver to Colorado Springs are 11 circuits and more going up. From Denver north to mining and agricultural districts there are five circuits. From Colorado Springs south to Pueblo are five circuits. Although, as said before, the great business of Colorado is mining, the toll lines to the agricultural districts along the river valleys east of the mountains do a good business. The toll line construction of this company is very substantial, being similar to the regular long distance construction in the Eastern States. The wire used is No. 7 B. & S. gauge, hard drawn copper.

As to exchange work in the larger cities, the Colorado Springs exchange occupies a unique position. Here is found an exchange in a city of 21,000 people with 900 subscribers and wires underground in all the business portion of the town. The toll line business out of the Colorado Springs exchange each day exceeds in actual volume that going out from the Kansas City exchange, where the population is more than ten times as great. The reason for this unusual state of affairs is that Colorado Springs has as many wealthy mine owners and health seekers as residents. Although the last census gave Colorado Springs 21,000, the population actually served by the exchange is probably (including neighboring towns) about 28,000. Even at this the number of people per telephone would be 31. This figure is exceeded by some exchanges where a nickel-in-the-slot 10-party-line service is given, but this service has not been introduced to any extent in Colorado Springs. This exchange is the first one in the State to be equipped with the central energy system.

At Denver, with a population of 132,000, the exchange has 4500 subscribers. About 500 of these are on nickel-in-the-slot 10-party-line service, with a 5-cent per day guarantee. This service is also being introduced in the other principal cities of the State. These nickel-in-the-slot 10-party-line instruments have a nickel device made at Denver by the Colorado Telephone Company. It operates on the usual principle with push button and buzzer circuit. The company is also giving measured service to those who want it. The records of this are kept by the operator. Each call is registered by the operator on a slip giving the time of day and number called.

At Pueblo is another prosperous exchange, with 650 subscribers in a town of 28,000 population.

This article would not be complete without a few words as to the general policy of the company, which differs somewhat from that which has prevailed in the East, and which to some extent accounts for the comparative weakness of the independent movement in the State. The policy as to toll lines has already been mentioned. In the smaller towns the company has never made any effort to limit the use of a telephone to the subscriber, except when the subscriber desired help in that direction. In the larger cities, at the time automatic pay station telephones were first established in drug stores, the druggists complained that people went to nearby private telephones, and an effort was made to stop it. Aside from this, every one has been rather encouraged to use the telephone freely on the theory that such use so encouraged the telephone habit that in time even "dead-head" users would become subscribers; and the more the telephone was used the more important it would become to every business man to have one. Of course, this policy had its drawbacks in imposing more work on the central office, but it certainly did develop the business and made the public feel more friendly toward the company. Other Western companies have followed the same course. The Colorado Telephone Company has so far kept out of towns where independent exchanges have been established. As Superintendent E. M. Burgess put it, "We do not like to have other people come into towns where we are established, and we think we ought to keep out of towns where other companies are already in," which, if one is willing to divide the business, certainly appears to be a fair and sensible way to look at the matter. On all exchanges, a free service is given to subscribers with-

in a 15-mile limit. While General Manager Field believes in the nickel-in-the-slot 10-party-line instrument as a means of popularizing the telephone and serving a certain class that could not before be reached, he thinks any company in introducing it should adopt the slow but sure policy and be sure the quality of service is not going to suffer by the sudden acquisition of a great number of this kind of instruments before the exchange is ready to take care of them.

Annual Meeting of the Engine Builders' Association of the United States.

At the annual meeting of the Engine Builders' Association of the United States, held at New York Dec. 4, concerning which a preliminary note appeared in our issue of last week, Prof. John A. Sweet, the retiring president, in an address set forth the objects of the association as follows:

"The promotion of the interests of the engine trade by the advancement of engineering knowledge and practice, by the cultivation of mutual respect and acquaintance and the maintenance of a high professional standard among members; comparing and standardizing methods promoting economy in operation, and the advancement in general of the interests of the trade as a whole."

Three papers were read before the association; one by Mr. H. C. Ebert, of the Westinghouse Electric & Manufacturing Company, on "Inter-relations Between Engine and Generator Builders in Connection with Engine Type Units for Power Purposes"; another by Mr. E. T. Armstrong, of the Ball Engine Company, on "Economy Guarantees of High Speed Simple Engines," and a third by Mr. H. G. Reist, of the General Electric Company, on "Some of the Requisites of Modern Lighting Generator Sets." The latter paper is reprinted in full elsewhere in this issue.

Mr. Ball reported to the association as a member of the committee appointed by the American Society of Mechanical Engineers on the subject of standardization, that a meeting of the committee had just been held and progress reported. The committee asked that no action be taken at the present time, and that no stardards be adopted until the A. S. M. E. committee had an opportunity of meeting and discussing the matter with the committee appointed by the American Institute of Electrical Engineers on the same subject, as the standards suggested by the A. S. M. E. did not entirely agree with the suggestions which they understood the committee of the A. I. E. E. has considered advisable. Continuing, he said, the object is to find out what has been done in the past and render the practice uniform as far as possible. It was probable that two standards for the size of the shaft will be necessary, one for centre and one for side crank engines. The two committees agreed on the subject of speeds, and at present would not take up alternating current generating sets.

Most electrical companies use one size of armature, thus doing away with the necessity for sleeves, nuts, etc. The committee asked if the association considered one or two standard sizes for shafting desirable. The most serious difficulty seemed to be in the length of the shaft between the centre of the engine to the outer bearing.

Two types of generators were in use, one parted horizontally and the other vertically, thus necessitating two styles of bases for dynamos. Possibly one style of base might be made, having the plane low enough for one type, and stools used, either cast into the base or bolted to it for the other type.

Mr. Ball asked that Mr. Sweet should attend a conference between the two committees to be held the next day. Mr. Ames in behalf of the society thanked the committee for its work.

Mr. Wood asked Mr. Ebert what suggestions he could make for the engine man to follow in order to meet the requirements of the electrical manufacturer. Mr. Ebert suggested that they should get together at the start instead of finding changes necessary after the customer had received the generating sets, and had discovered that the engine and the dynamo did not agree. He said he believed that consulting engineers were largely to blame for making requirements which were sometimes altogether unreasonable.

Mr. Bird spoke on the subject of the pressing on of the armatures. He said that it was a great inconvenience, that it was not always understood who should do the work. That in their plant (Ball & Wood Company) they now bore a hole in the end of the shaft of a uniform size and use a stud bolt to insure the fit. Mr. Ebert approved this practice and suggested that the electrical manufacturers would welcome it becoming general.

Mr. Palmeter discussed the question of overload capacity, the subject of the length of the shaft and the height of the base. Mr. Ball stated that the height of the base would probably soon be settled now, and that the General Electric Company was already meeting this question, but that the overload capacity was a serious matter. If too much is asked, the plant becomes unnecessarily costly and frequently prevents a man investing because of the initial cost. The electrical engineer was largely to blame for this in encouraging a man to ask for too large an overload capacity as compared to his actual needs, and Mr. Ball suggested that there should be a limit placed on the overload capacity to be called for. Mr. Ebert stated that that would probably adjust itself, that the Westinghouse Company now would not agree to over 50 per cent overload capacity, and are doing all they can to keep down the demand for excessive overload capacity. Mr. Gates said that the engine builders would gladly join the electrical manufacturers in that move.

Mr. Stett suggested that it would be well for dynamo builders to specify more exactly what would be required of the engine in regard to the speed variation in each case.

Colonel Dick said that when the dynamo first came into use electricity was regarded as an "occult science." Men entirely ignorant of electrical subjects were put on the road and made propositions, which the purchaser knowing very little if any more than the seller about the subject, accepted as necessary, and which the engine man had to meet, no matter how absurd. Fortunately that condition has passed now, and the engine builder and the dynamo builder are gradually coming closer together. The engine builder and electrical men should have a standard that all could agree upon, and that would set aside unreasonable demands.

Mr. Stett brought up the question of getting plans more promptly from the electrical manufacturers so that the engine builders could have more time on their work. Mr. Ebert said that if no special designs were called for plans could be quickly given, but so many special machines had to be built and they naturally were hindrances to getting out plans promptly. Mr. Reist suggested that a standard of units should be adopted.

Mr. Wood made a motion that the committee from this association should meet the committee of the other associations concerned and take this matter up thoroughly, as the question was one of great importance and one which should be decided as soon as possible for the mutual benefit of both the engine builder and the dynamo builder.

At the end of the executive session Mr. William M. Taylor, of the Chandler & Taylor Co., extended an invitation to the association to hold their next annual meeting at Indianapolis, which invitation was accepted. In the evening a dinner was served at Sherry's, at which some thirty-five members and guests were present. The affair, under the guidance of Mr. Wood, was most enjoyable.

The First Annual Meeting of the Illinois Electric Association.

The first annual meeting of the Illinois Electric Association was held at Champaign, Ill., Nov. 27. This association was organized April 24 at Springfield, Ill., with Mr. J. D. Gerlach as president; E. H. Hillman, vice-president; H. C. Chubbuck, secretary, and D. Davis, treasurer. At the same time an executive committee was appointed, as follows: E. X. Leseure, W. H. McKinley, R. L. Allen, H. S. Green and D. C. Copley. Largely through the excellent work of the secretary of the association, who has devoted much time in advancing its interests, the membership has increased from the twenty at the close of the Springfield meeting to eighty members at the present time. The next meeting will be held at Rockland, Ill., the fourth Tuesday in November, 1901.

The meeting was held in the engineering hall of the University of Illinois, and the members were welcomed and addressed by President Draper of the University. He spoke of the healthy growth which had recently characterized the University, and referred to the College of Engineering as one of which every Illinoisan might well be proud. The College of Engineering has six departments—architectural engineering, civil engineering, electrical engineering, mechanical and railway engineering, municipal and sanitary engineering and physics, and the building which they occupy is the most complete and best equipped building in the United States exclusively devoted to engineering. having been erected in 1894 at a cost of $155,000. As illustrating the growth of the University, he stated that in 1890 519 students were registered, while at the present time over 2500 are enrolled.

The chairman of the committee on mutual insurance, Mr. J. J. Frey, reported that he had corresponded with many mutual insurance companies, and found that the minimum rate of charge was 1½ to 3½ per cent, and that companies so insured were receiving rebates which made the insurance from 15 to 90 cents per $100. In the afternoon the association met in the physics lecture room to listen to a lecture by Prof. A. P. Carman on "High Potential Phenomena," after which the members assembled in front of Engineering Hall to have a good picture taken, and afterwards to inspect the University grounds under the guidance of Prof. Aldrich.

At a meeting late in the afternoon the following officers were elected for the ensuing year: President, J. D.Gerlach, of Chester; vice-president, E. B. Hillman, of Barry; secretary, H. C. Chubbuck, of Quincy; treasurer, D. Davis, of Litchfield. Executive committee: Messrs. J. H. Baker, of Sullivan; W. B. McKinley, of Champaign; R. L. Allen, of Joliet; W. H. McCullough, of Beardstown, and J. F. Porter, of Alton. The following members were named to serve on the committee on coal, freights and transportation: L. A. Ferguson, of Chicago, chairman; R. S. Wallace, Peoria; W. A. Martin, Quincy; W. E. Steinwedell, of Beardstown, and John W. Gliddon, of DeKalb. A committee on heating was also named as follows: Chairman, C. E. Hay, of Springfield; H. G. Frith, Watseka; C. H. Langford, Paxon; W. E. Steinwedell, Beardstown, and J. N. C. Shumway, Taylorville.

The members of the association assembled in the dining halls of the Hotel Beardsley at 8 p. m., and after a banquet Prof. W. S. Aldrich was introduced, and made some remarks concerning the great future of electricity and the desire of the University of Illinois to remain in touch with its practical exponents, of which the association was an important representative. Mr. E. C. Hay, of Springfield, Ill., responded to the toast, "Meters vs. Flat Rates," which gave rise to considerable discussion. Three of the speakers considered that meter rates are impracticable in small towns. Mr. F. A. Brooks, one of these, said that "the meter system was a failure in a small town; but in towns of eight or ten thousand inhabitants it is suicide to attempt to run on the flat rate system"; he added that "the amp.-hour meter is a failure." Other members spoke of the excellent results obtained when the companies changed over from flat rate to meters. In the discussion of a response to a toast by Mr. W. J. Ferris, on "Enclosed Long Burning Arc Lamps," Mr. J. S. Daily, of Chillicothe, said that the use of enclosed long burning arc lamps did not always prove satisfactory on account of the globes becoming coated and having to be renewed very frequently. Mr. Ferris said that if properly trimmed, the carbon could not burn down so as to melt the globe, and that improper trimming is also the cause of discoloration of the globe. Mr. P. A. Bertram, of Peoria, said that he finds that a small brush is the best instrument to use for cleaning globes. He uses 500 enclosed arc lamps on his circuits, which are taken care of by one man, who also does the repair work. Secretary Chubbuck said that 400 enclosed arc lamps are in use in the Quincy plant, and that one man trims all of them.

In the discussion of the toast, "Desirability of Moderate Sized Cities Operating Day Power Circuits," Mr. C. H. Langford, of Paxon, said that his plant is running a day circuit which adds about $300 per month to the receipts. No more men are required to run the day circuit and but little more coal is used. He considers that the whole question of the advisability of running a day power circuit depends entirely upon the amount of business which one is able to get. The toast "Should Central Stations Furnish Incandescent Lamp Renewals Free?" brought forth a diversity of opinion. Mr. D. Davis, of Litchfield, said that he was in favor of free renewals, while Mr. H. J. Pepper, of Champaign, said that the public does not appreciate something that is given them gratis, and that they will not even be thankful for free renewals.

London Underground.

A London cablegram says: "Trouble threatens London's new tube road. Many residents under whose houses the electric trains run have combined to sue for damages alleged to be caused by vibration. They have subscribed £10,000 for litigation in the courts. They maintain that though the tube is at an average of fifty feet below the surface, the windows of the houses are rattled, the occupants awakened, and ornaments shaken every time a train passes. If any degree of success meets their efforts, it will seriously retard the attempt to give London decent rapid transit." Similar legal attempts made before proved ridiculous failures. But in England, as in America, a corporation is good game.

Train Lighting at the International Railway Congress.

One of the important congresses held in connection with the Paris Exposition during the past summer was that of the railway industry. Its proceedings were of great interest and importance and are now more or less accessible in printed form.

As usual at the other congresses, topics were taken up by way of reports and two of the ablest reports were in relation to the question of train lighting, embodying a complete résumé of the various methods of lighting railway carriages which have obtained on the Continent and in the United Kingdom from the early days of the railways to the latest improvements and perfections, including electric lighting, acetylene, gas, etc.

The first of the reports in question was prepared by M. Chaperon, engineer and chief of a division of the Paris, Lyons & Mediterranean Railway Company, in collaboration with M. Herard, assistant chief of transportation of the Orleans Railway Company, and embraced all the countries of the Continent and the United Kingdom, except Austria-Hungary, Roumania, the Netherlands, Luxembourg and Germany.

The above named countries not embraced in the first report were included in the second report, which was prepared by Cajetan Banovits, a ministerial councillor and director of rolling stock and locomotives of the Hungarian State Railways.

It is to be regretted that so little information was furnished the reporters by the railways of Germany and the United States, but the information derived from the experience of the other countries has enabled the reporters to present, as the result of their labors, a most valuable contribution to the knowledge of the subject and a most comprehensive comparison of the various methods employed.

The early methods of lighting by means of candles and oil—animal, vegetable and mineral—some of which still obtain on some of the smaller lines on the Continent—are reviewed exhaustively and their merits and defects are fully set forth, statements being made in detail with respect to gas and electric lighting—the two great systems now competing for favor in this country as well as abroad—including under the former gas from petroleum, and other mineral oils, pure acetylene and gas mixed with acetylene, and under the latter the systems of electric lighting from storage batteries alone and from storage batteries in connection with dynamos.

Report No. 1, by MM. Chaperon and Herard, sets forth candidly the merits and deficiencies of each system. It says: "The railway companies have aimed at a result, if not perfect, at least very satisfactory, by different methods, either in perfecting the apparatus for using oil or petroleum, or in multiplying their number—or by recourse to new and altogether different systems, viz, gas or electricity. With oil lighting the expense of installation is comparatively low, but it requires a numerous staff for cleaning, filling and maintaining the lamps. It is requisite that this work should be carefully done, as the quality of the light and the economy of the system depend absolutely on the manner in which it is done; finally, the quality of oil, wicks, etc., have first importance. All these necessary conditions required in good oil or petroleum lighting bring the cost per lamp-hour to quite a high figure.

"In gas lighting the cost of installation for the manufacture and supply of the gas is quite considerable. The expense for labor is reduced to the minimum, the services of the staff being limited to wiping the cups and chimneys of the lamps, the examination of the burners and supplying the reserves or tanks of the carriages. The advantages of the system are principally in the quality of the lights, the facility of modifying the intensity as well as the simplicity of the labor in maintenance and cleaning and in the activity in filling the supply tanks.

"The lighting power of the gas may be still improved by mixing it with highly carburetted products. Several of these have been made use of, among others naphthaline (albo-carbon), which has not given very good results; acetylene mixed with gas in the proportion of 25 to 30 per cent gives the flame a very considerable intensity and fixity."

Coming at once to the question of lighting by electricity the report says: "Electric lighting is, without contradiction, that which is presented under the most attractive form. Incandescent electric lamps have ,in fact, an incontestable superiority over all the other methods of lighting, as much from the point of view of comfort as that of facility of installation of luminous centres, which may be as intense as desired and which can be placed at the most convenient points for the passengers. They produce no, or next to no heat, and there is no occasion to provide for the products of combustion being carried out-

side. The electric lighting of the carriages produced by means of a dynamo driven by the axle during the run of the train realizes, in principle, a complete and rational system of lighting."

This report concludes with a query for discussion as to whether the equipment provided to assure constancy of voltage will be likely to deteriorate in service, and whether its maintenance will be expensive. Also whether regular inspections of the parts will tend to cause too great a degree of immobility of the rolling stock.

The report gives a table as follows of the electric car lighting in different countries: United States of America, 74 cars; France, 1830; Great Britain, 112; India and British colonies, 600; Italy, 160; Switzerland, 697, making a total of 3483 carriages. Apparently methods of axle driving are gaining everywhere in popularity and success. The figures for the United States appear imperfect.

The second report was prepared by Cajetan Banovits, ministerial councillor and director of rolling stock and locomotives of the Hungarian State Railways. It embraced the countries of Austria, Hungary, Roumania, the Netherlands, Luxembourg and Germany. Passing in review the systems of candle lighting and oil lighting which are still maintained by quite a number of the railways for at least a portion of their equipment, alongside of systems of a more up-to-date character, he concluded his remarks as to oil lighting by the statement that notwithstanding some of the inconveniences attending its use, there are some advantages such as relatively great security against the dangers of fire and explosions, relative cheapness, the independence of each light and as an auxiliary in case of necessity. In view of this it is not astonishing, he says, that this mode of lighting should still be used by administrations who maintain it upon their principal lines, as well as by others who, using more perfect methods for trains of the first order, for trains of the second order still adhere to oil lighting.

Speaking of gas from mineral oils or gas enriched by acetylene, he commends the attainment of a luminous intensity great as compared with oil lighting and the simplification in maintenance of the apparatus for lighting. But he says despite these incontestable advantages, gas lighting has had but a comparatively slow development, owing to the fear of fire so much greater than in the case of oil lighting and explosions—altogether absent in oil lighting. Speaking of the enriched gas, he says that the method if not the best, is susceptible of improvement, and is of a sort to dispute the ground with other innovations. But in spite of the indisputable advantages brought by gas lighting, it is not exempt from certain inconveniences, and the eventuality of danger from fire and explosion forces the consideration as well by those lines possessing gas plants and equipment as by those who do not, of another method of lighting exempt from all the inconveniences and furnishing a luminous intensity of greater perfection.

The question of improving methods of lighting in general does not apply exclusively to railway administrations. In that which particularly concerns the lighting of trains, it is to electricity that we must necessarily have recourse, in view of the incessant progress of electrical science, and by it the question of lighting will be in every respect determined in a satisfactory manner. Referring to a system used by the Austrian railways where the dynamo furnishes 60 per cent and the storage batteries 40 per cent of the current for lighting the train, the cost is placed in round numbers at 13 francs ($2.60) for 10,000 lamp-hours. The advantages of electricity compared with other methods of lighting may be summed up as follows: Absolutely fixed light; exemption from atmospheric influences such as wind and cold; facility of being placed according to needs and wishes; possibility of great economy in the lighting by ability to reduce the period of the lighting to the minimum of time consistent with effective need; its great cleanliness and simplicity of maintenance, as also for lighting, lowering or extinguishing the lamps—those operations being made rapidly and without labor, and avoiding entirely the inconveniences which lighting from the car ceiling entails.

Another advantage not less important but also extremely valuable is that the danger of fire which, generally speaking, is not absent from the other methods of lighting, is here entirely excluded. With this method of lighting disappears in fact one of the possibilities of danger to which a railway train is exposed, hence an increase of security in train movement. All of the inconveniences to which reference has been made, are largely compensated for by the advantages cited and will be more so as the application of this method of lighting is made upon a larger scale and as the progress in the manufacture of the accumulators and of the lamp is secured.

The relatively high cost of gas lighting with respect to the imperfect luminous intensity which it affords and perhaps also the favorable results obtained by electric lighting with respect to luminous intensity have induced the partisans of gas lighting to seek means for remedying the defects of that lighting. The important auxiliary factor of acetylene lighting has come to their aid and a suitable mingling of acetylene and gas has enabled them to obtain a light able to compete seriously with electric lighting.

The experiments made up to this time with pure acetylene have not resulted in anything practical, and this lighting has not been applied to any of the roads in the German Union; only the South Austrian and the Roumanian State Railways have made trial with this gas. But on the contrary the Prussian State Railways have adopted the mixed gas lighting, and this new method of lighting has already replaced the "Riche" gas in nearly all of its carriages.

Under the head of final observations, M. Banovits says: "In fact it cannot be concealed that between the methods of lighting by candle and oil on the one side and electric lighting and mixed gas lighting on the other, the difference is immense. The luminous intensity which has been secured (and which may yet be surpassed by these two last methods of lighting) is such that it unites perfectly all the requirements; and finally electricity presents a complete security against dangers of fire and explosion."

Commenting upon some points of disadvantage, which on the Continent electric lighting seems to have, compared with the mixed gas, he says: "Electric lighting has for itself the immense advantage of perfect security against the dangers of fire and explosion. This advantage compensates largely for all the inconveniences in the system—in fact to-day in any instance of a particularly delicate nature, such as in the trains of the royal families, the transportation of objects of great value, etc., preference is rightfully given to electric lighting.

"If in the special cases we have just enumerated, the taking into consideration of the greatest security is justified, it is proper to examine also into the question of running if it would not also be proper to take it into account from the general view of the passenger service. It cannot be denied that in spite of all the precautions taken by the railway managements, it is scarcely possible to arrive at absolute security against railway accidents. The possibility of such accidents being granted, it requires only the combination of unfavorable circumstances that the catastrophe should be of the largest proportions.

"Finally it should be noted that the method of electric lighting generally made use of—by storage batteries exclusively—is not the only method of applying this light. It is not denied that the experiments actually in course of trial by some of the lines of the German Union system, either by means of a moving vehicle producing the current for the whole train or by the production of the current required for each particular carriage, partly by a dynamo driven by the motion of the carriage itself and partly by storage batteries—may be crowned with success; nor that the results obtained either under the item of expense as under that of simplification of the maintenance, may be more favorable than those realized in the exclusive use of storage batteries upon a large scale, that is to say under normal conditions."

If account is taken of the incontestable superiority of the electric lighting, notably in all that concerns security against the danger of fire and explosion—an advantage which strongly pleads in favor of the application to the trains of the electrical mode of lighting—it is likely that the railways managements which up to now have not thought it right to dispense altogether with the cheaper systems and have hesitated in view of the greater expense which the adoption of electric lighting entails, will finish by adopting it. There will result therefrom a new and notable progress in the direction of safety in the movement of trains.

M. Banovits sums up as follows: "Of all the modes of lighting adopted up to the present time for the lighting of trains, that which seems to us to answer the best to the conditions of a perfect light is electric lighting, for besides offering *the greatest security* (the italics are those of the report) against the danger of fire, it possesses a proper luminous intensity, assures a light, clean, fixed, exempt from atmospheric influences, and permits a simple and economical dimming for the night. This mode of lighting has moreover the advantage of a simple maintenance and as soon as its application is made upon a large scale, a service will be assured by proper installations, which will be regular and rapid, even in cases of the densest train movement. Everything in short invites to the belief that from the pecuniary point of view this method of lighting will permit more favorable economical results than have hitherto been attained; and under this head it may pertinently be remarked that the advantages which at the moment other methods of lighting may appear to present over electric lighting are largely offset by the superiority of safety conditions and by the other inherent advantages of the method."

CURRENT NEWS AND NOTES.

TAXATION IN GEORGIA.—In the Georgia Assembly a legislative committee has acted favorably on bills to tax the franchises of railroads, street railroads and other concerns exercising the right of eminent domain.

PORTO RICAN TELEGRAPHS.—General Greely, Chief Signal Officer United States Army, has been informed that the Signal Corps telegraph lines in Porto Rico have been turned over to the control of the civil authorities of the island.

AUTOMOBILE EXPOSITION.—The Automobile Club of France will hold its third international exposition of automobiles in Paris, in the Grand Palace of the Champs Elysées, from Jan. 21 to Feb. 10. It promises to be a great success.

ELECTRIC POWER IN CEMENT WORKS.—The Lakefield Portland Cement Company, of Lakefield, Ont., will have its works operated entirely by electricity. The water power is situated about five miles from the works to which electric current will be transmitted at a pressure of 10,000 volts, and transformed at a sub-station at the works. In the works fourteen motors, of various powers, will be distributed to provide power for the different departments of manufacturing. The installation is now in progress. After the works are supplied it is the intention of the company to furnish light for the town.

END OF THE PARIS EXPOSITION.—Throughout the buildings on the Champ de Mars and Invalides desolation, writes our Paris correspondent, now seems to reign. It was incredible, almost, to see the sudden upheaval in all directions on the day following the last visit of the public. Everywhere there was the greatest activity displayed in getting together the empty packing cases from the storerooms, and by the end of the day it appeared as if several days' work had been accomplished. Only the large engines appeared intact; but now they are being dismantled, and shipments of all kinds of goods are going forward as quickly as they can be boxed up. Certainly much red tape is needed to satisfy all the various officials as to the legality of proceedings, but the present state of advancement has called forth exclamations of astonishment in most quarters, and the six weeks' limit allowed for removing exhibits appears to be more than ample time for all except the large and heavy machinery which adorned the Palace of Electricity.

TELEGRAPHING TO THE ANTIPODES.—A special despatch from London of Dec. 8 says: "Marconi claims to have completed a scheme by the erection of wireless telegraphy instruments along the coasts to keep in continuous touch with ships practically the whole way between England, Australia and the Far East, at 4 cents a word, as compared with $2.40, the toll now paid to the antipodes." A number of ocean liners are now equipped with Marconi instruments, in order to announce their approach to the coast; lightships employ the same means to report wrecks and summon aid from life-saving stations on shore, and a successful test has been made of an automatic device for warning vessels in a fog of the proximity of dangerous rocks. A transmitter capable of sending out waves for seven miles has been operated by clockwork, and made to repeat the word "Fastnet" at intervals of three minutes. A ship on which there was a Marconi receiver, and which came within the range of the signal, would learn of its peril in ample time to change its course.

THE LATE SENATOR DAVIS.—Among the floral tributes at the funeral of Senator Davis, of Minnesota, who died recently, was a design sent by the Old Time Telegraphers' Association, on which was marked in immortelles the telegraphic symbol: "Thirty," which means "good night" and is the last word sent by the operator before he closes his office. This tribute recalls the fact that Mr. Davis was an expert telegraph operator before he entered the army during the civil war. As lieutenant with his regiment in Arkansas he had occasion to make use of his knowledge of the key, and when the Confederates captured Little Rock Mr. Davis sent the last message to the city before the wires were cut. He had tapped the wire in the field and was talking with the Confederate operator in the city, and getting a considerable amount of information for use of the army, when the operator at Little Rock flashed a message over the wire, "Good by, Yank; I hear your men's guns outside the city and am going to cut the wire." Senator Davis was not only a highly accomplished lawyer, but a tremendous reader. His special hobbies were books and engravings relative to Shakespeare and Napoleon.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—A base measuring apparatus which has been perfected in connection with the Summer School work of the Civil Engineering Department of the Massachusetts Institute of Technology for a few years has recently been tested by the Coast and Geodetic Survey in Washington. Such satisfactory results have been already obtained and others assured that the apparatus is about to be used in the important Lampasas Base in Texas. Professor Burton, of the Institute, under whose direction the apparatus has been worked out, has been invited to accompany the expedition, which is to make a careful trial of the method in the field and upon extended exact work. The apparatus represents the final results of thesis investigations by several graduates of the Course in Civil Engineering who have worked upon it in successive years. One part of the apparatus maintains a constant tension in the steel tape while in use. Another part of the apparatus determines very accurately the mean temperature of the tape by measuring its electrical resistance by means of a special form of thermophone devised by two graduates. The complete apparatus is not bulky and is of high value for exact measurements.

THE CAPITAL POWER COMPANY, OTTAWA.—The electric power house of the Capital Power Company, of Ottawa, Ont., was formally opened on Dec. 3. This new electric power plant is situated at Deschenes Rapids, about seven miles from Ottawa, and was built by the Conroy Bros., lumbermen of that city, for the purpose of furnishing power to mills that are miles away from Deschenes. In order to carry out this electrical development, the Messrs. Conroy arranged for the incorporation of the Capital Power Company. The capital of the company is placed at $300,000. Work was commenced in February last, and has been pushed with great rapidity. The electrical plant consists of eleven turbines and two generators. Each of the latter is of 800 kilowatts capacity at a pressure of 10,000 volts. The amount of electrical power developed at the present will be 2500 horse-power. Practically the whole of this has been leased by Mr. E. B. Eddy for his sulphite and paper mills at Hull, five miles distant. In addition there are two turbines driving a plant which has been leased to the Hull Electric Company, totalling 332 horse-power, and two turbines driving a plant for the Deschenes Milling Company, giving 175 horse-power, making a total of 3015 horse-power. There are facilities for doubling the present development.

AUTOMOBILES IN AFRICA.—Col. R. E. B. Crompton, the well-known electrical engineer, has recently delivered an interesting address in London on the use of traction engines in South Africa. When Lord Roberts wanted to put heavy guns into a position which was difficult he always sent for traction engines. The engines did twice whatever the Boers did, and twice whatever the English sailors did, although the latter had by pluck and muscle got guns weighing 5 or 6 tons into difficult positions. The lesson of the war as regarded automobilism was striking. The whole of the Transvaal was one mass of dead animals; it was impossible to feed them, and they died of starvation. The great outbreak of enteric fever was caused by the mass of dead and dying animals, but there was not a dead traction engine in the whole of South Africa. To show the importance of automobilism he said that when he was managing a line of steam traction from Pretoria to Rustenburg, they carried about 130 tons of food per week for two columns 20 or 30 miles west of Pretoria. Thirty tons of that amount was food for men and 100 tons food for horses and mules. If they could have supplied self-propelled vehicles to the columns they could have cut down the weight to 7 or 8 tons of fuel in place of the 100 tons of forage. It would be found, he declared, if it had not been already proved, that all the heavier things, such as guns, wagons, engineers' park, etc., could be transported most successfully by self-propelled machines either steam or oil. It was important that something should be done to relieve the English cavalryman and mounted infantryman of the huge weight the horses had to carry. He wanted to see the service supplied with some light vehicle that could accompany the cavalry and mounted infantry and carry part of the weight which killed the horses and destroyed the mobility of the British army. As an instance of what traction engines had done in South Africa, Colonel Crompton stated that he had seen engines take a 10-ton gun up a gradient of one in five at the rate of a gallop.

TRANSPORTING HORSES AT SEA usually involves loss. Capt. A. W. Butt, U. S. V., crossed the Pacific with a load of 456 horses, of whom only one died. Among the apparatus used to promote the health of the live stock were electric fans.

TELEGRAPH TAXATION.—The schedule before Congress for the reduction of taxation proposes to drop the 1-cent tax on telegrams. This is estimated to make a difference of $800,000, showing that in this country about 80,000,000 telegrams are paid for annually, or one per head only of the population. The tax has been a nuisance and not worth collecting. The telephone tax is also to be dropped.

ST. LOUIS FAIR.—On Nov. 5 a check for $250,000, the largest subscription yet made to the World's Fair local fund of $5,000,000, was handed to William H. Thompson, chairman of the finance committee. It came from the St. Louis Transit Company and the Suburban Railroad, the two companies controlling the street railways of St. Louis. This was the sum originally proportioned to the street railway interests, and this subscription has made the closing of the local fund a comparatively easy matter.

PNEUMATIC TUBES FOR CHICAGO.--Boston capitalists are taking active steps to give Chicago a pneumatic tube service, similar to the one operated in Boston. An important advance has been made toward the completion of the plans of the Eastern capitalists by the incorporation of the Illinois Pneumatic Service Company, with a capitalization of $100,000. Among those said to be interested in the enterprise are W. L. E. Dillaway and Oakes Ames. Counsel for the Eastern syndicate said that it is hoped to have the system in operation inside of six months.

INCANDESCENT LAMP FILAMENT.—The manufacture of an incandescent lamp filament is described in a patent issued Dec. 4 to Alexander Just, of Austria, the filament consisting of a mixture of carbon and a refractory nitride of a metalloid; 10 to 35 parts by weight of boron nitride is mixed with one part of carbon, boron or silicon. To the mixture is added a sufficient quantity of suitable binding agent, such as hot coal tar, to convert it into a plastic mass, from which the incandescent filament may be obtained, the latter then being carbonized out contact with air.

LINEMEN'S STRIKE ON PACIFIC COAST.—A general strike of Pacific Coast linemen took place Dec. 1. The officials of the linemen's union claim that 500 men have gone out, including 200 in San Francisco. The strike is for the purpose of obtaining $3 per day of 8 hours, and also recognition of the union by the electric companies. Telephone linemen have been out for several weeks in Seattle, Wash. It is claimed that the Postal Telegraph Company and the Independent Electric Light & Power Company, San Francisco, have agreed to comply with the terms demanded by the strikers. The latter company's underground men did not go out.

TROLLEY MAIL COLLECTION.—The plan of mail collection by trolley cars has been allowed to show its possibilities in Grand Rapids, Mich. There all mails are carried between stations and the Post Office on the trolley cars, and, in addition to this, there is a letter box attached to the guard of the forward platform of every car, and when anybody wants to mail a letter he stops a passing car and drops the letter into the box. One great advantage is in the case of urgent letters written in remote parts of the city too late for the last collection by carrier. The other advantages of the scheme are apparent, and it ought to be extended to all cities having, like Grand Rapids, a trolley system with a common centre.

A. S. M. E.—At the second meeting of the American Society of Mechanical Engineers, held last week, the following officers to serve for the coming term were elected: President, Samuel T. Wellman, of Cleveland, Ohio; vice-presidents, David Townsend, of Philadelphia; Jesse M. Smith, of New York; James M. Dodge, of Philadelphia; Stevenson Taylor, of Hoboken; Arthur M. Waitt, of New York; Ambrose Swasey, of Cleveland; Edgar C. Felton, of Harrisburg, Pa.; R. H. Soule, of New York; John H. Brashear, of Allegheny, Pa.; A. M. Goodale, of Waltham, Mass.; Francis H. Boyer, of Somerville, Mass.; Alfred H. Raynal, of Washington, D. C.; W. F. M. Goss, of Lafayette, Ind.; De Courcy May, of Scranton, Pa., and D. S. Jacobus, of Hoboken; treasurer, William H. Wiley, of New York.

A FLASHY HAT has been the cause of an interesting suit for damages in which the complainant, Frost, got a verdict for $5,000 against the Pinkertons. Frost was arrested during a famous fight made by Philip Dwyer against the poolrooms in 1891. Mr. Dwyer barred out the wires of the Western Union Telegraph Company to prevent the poolrooms from getting the results of the races. Frost and several companions, it is alleged, went to the races armed with electrical appliances for flashing the information desired by the poolrooms. It is asserted that the coachman on the carriage in which Frost and his companions were wore a high hat. In the top of the hat was a hole about the size of an egg. Inside the hat the coachman had an electric light. By means of a code of signals the results of the races and the betting were flashed to operators stationed in the cupola of a hotel opposite the grounds. The Jockey Club officials had Pinkerton arrest Frost. Both Frost and his wife, who were in the carriage, assert that they were roughly handled by Pinkerton's men. The facts as to the electrical apparatus were duly attested in the trial of the case.

ELECTRICAL SECURITIES.—Mr. Hugh Dougherty, addressing the Indiana Bankers' Association recently on the subject of investments, and comparing steam railroads with the later electrical enterprises, said: "They have been great securities. They have been put before them and the banks have been able to continue their business, at great profit, because the people were compelled to patronize those institutions. This same thing now applies to the electric roads —the electric roads in the great cities—because of the necessity of quick transportation there has been an immense amount of capital put before the banker and before investors, and that has been very profitable, because the common people, everybody, must patronize the street railway. The interurban roads are taking the same position. They are now getting themselves in a position where they are handling freight and express matter and all that sort of thing, and they are carrying people to and fro, and the people must patronize those institutions. That has been a good investment, but all those investments have passed out, and have passed from under us who live in Indiana, so that we must seek after something else; and while it may be considered to some extent personal on my part, yet I think I see in the telephone a desirable future investment. When I say telephone I mean you to understand strictly the independent system of telephones in this country. I see in that thing a great future. I am sure that the telephone is one of the institutions which, when the hard times come, it will be discovered does exist and will continue to exist because it is an economizer of time and space, and there is no evidence, so far as the telephone is concerned of its ever going out of use.

THE CINCINNATI EDISON COMPANY.—As was recently noted in these columns, the Cincinnati Edison Company has for some time past been annoyed and harassed in many ways in the development of its business. A great many obstacles have been interposed to prevent its placing its wires underground; to prevent the making of extensions into the residence portion of the city, and in general to hinder in every way possible the taking on of new customers. These attempts have resulted in failure, however, so far as the final results are concerned. The company has secured a new overhead franchise, permitting it to go throughout the limits of the city as they are now and may hereafter be extended. It has also secured a new perpetual underground franchise, good throughout the city. Under these new franchises the company has been granted permits to place its wires underground throughout the central or business portion of the city, and this work is now being done. It has erected a new storage battery plant which is now being put into operation. During the past ten months the company has increased its customers by over 125 per cent, and added about 60,000 16 candle-power equivalents to its connected load. The company is taking new business at the rate of 5000 16 candle-power equivalents per month, and expects to have a very large growth during the next year. The means adopted to hamper the company are sometimes of the most dangerous character. A short time ago the water in a boiler was turned out, but the fact was discovered in time to prevent an explosion. At another time borax was put into the lubricating oil, with the evident purpose of so damaging the bearings as to cause a shutdown of the plant. Wires have been cut and all sorts of things have been done by stealth to make the life of the Edison officials a burden.

RAILWAY TELEPHONE SYSTEM.—A patent was granted Dec. 4 to Elmer E. Carpenter, relating to a telephone system for use in connection with electric railways. An electric railway car carries a jointed pole, connected electrically to a telephone instrument on the car; at any time a telephone circuit may be established by making contact with a telephone wire strung along the line by elevating the jointed pole.

CHEMICAL ELECTRIC METER.—A patent was granted Dec. 4 to Thomas A. Edison on a chemical meter based on the fact that by subjecting a suitable soluble salt of mercury to electrolysis by a fraction of the current to be measured, the metallic mercury set free will correspond exactly to the current. The amount of mercury thus set free is deposited in the capillary bore of a glass tube, and the height to which it rises therein is read off by means of a scale similar to that of the thermometer; or the mercury may be accumulated in a receptacle suspended in a liquid and connected to a shaft which will be caused to act against the tension of a volute spring as the weight of the deposited mercury increases, thus moving an index over a scale.

RAILROAD UP MONT BLANC.—A scheme for building a railroad to the summit of Mont Blanc is being discussed at Geneva. M. Vallot, director of the Mont Blanc Observatory, and M. Deperet, professor of mineralogy at the Lyons University, have been examining the plans, which they regard as feasible. The most favored plan is to start the line from Les Houches, on the Savoy side, whence it is 11 miles to the summit of the mountain. The plans provide for 12 stations with every convenience for travelers. The trains will be propelled by electricity, which will be obtained by utilizing the River Arve, which now furnishes power for the electric road up Mont Saleve, in the suburbs of Geneva. The author of the scheme, M. Fabre, a Frenchman, has submitted his plans to the French Government.

THE TROLLEY IN CONNECTICUT.—Great activity continues to be shown in trolley development in the Nutmeg State. Eleven years ago there were fifteen horse railroads in Connecticut, and their total mileage was but little over 100 miles. To-day there are thirty-three separate corporations of the kind in the State, and these have absorbed in ten years some fifty smaller enterprises. The electric road trackage of Connecticut has increased to 500 miles. Additions and new enterprises have now established a continuous trolley line from Westchester County, N. Y., along the shore to Branford, ten miles east of this city, and branch systems have been built up the Naugatuck Valley, northward for twenty miles from New Haven, up the Hartford line, and from New London north. Cross-country trolley lines connect these systems and practically gridiron the State through its most important settlements. The plans of the electric roads for extensions this coming year will add greatly to the mileage already in operation. A through trolley line from New York to Boston has been the avowed ambition of the United Gas Improvement Company, which at present controls the electric roads from Stamford straight through to Milford along the Sound, and from Bridgeport north via the Naugatuck River to Waterbury.

CONSOLIDATION OF ELECTRIC AUTOMOBILE INTERESTS.—A deal which has been on foot for some little time past was completed last week when the Electric Vehicle Company bought the entire $4,000,000 capital stock of the Riker Motor Vehicle Company, its largest competitor, and will increase its own preferred and common stock each by $1,000,000 to effect the transfer. George H. Day was elected president of the Electric Vehicle Company, succeeding Robert McA. Lloyd, who remains a director. F. C. Stevens, president of the Metropolitan Street Railway Company of the city of Washington, who has been the president of the Riker Company, was made a director of the Electric Vehicle Company. H. M. Byllesby, first vice-president of the Riker Company, was chosen first vice-president of the Electric Vehicle Company, and W. H. Johnson, who has been general manager of the last named company, was elected its second vice-president. A. L. Riker, second vice-president of the Riker Company, was made third vice-president of the Electric Vehicle Company. Arthur Phillips, who has been the Electric Vehicle Company's secretary, was replaced by T. W. Goodridge. Frederick Vieweg was elected treasurer. John Jacob Astor resigned as a director of the Electric Vehicle Company, his place on the board at his request being filled by George Chapman, his business representative. Besides Messrs. Day, Byllesby, Johnson, Riker, Stevens, Lloyd and Chapman, the board of directors consists of P. T. Dodge, Herbert Lloyd, Martin Maloney, Col. A. A. Pope, T. J. Regan, Isaac L. Rice and Daniel H. Shea. President Day is also the president of the Electric Storage Battery Company. The Electric Vehicle Company has bought from Mr. Riker personally all his foreign-patent rights, the Riker Motor Vehicle Company having owned only the United States patents. The Riker Company will still retain its plant at Elizabeth, N. J. Its stockholders, however, will hold stock in the Electric Vehicle Company, instead of in the Riker. The transaction is simply an absorption of the stock of the Riker Company. The Riker Company had $4,000,000 worth of common stock and $1,000,000 worth of preferred stock. The Electric Vehicle Company had $8,000,000 worth of preferred and $10,000,000 worth of common stock. By the exchange of stock from the Riker Company its preferred and common stock will each be increased by $1,000,000. Mr. Riker has long been a pioneer in the automobile art, his work extending back for many years when very few others had given even the slightest thought to the subject. He has not only secured important patents, but has built in large numbers some of the best electric automobiles to be found anywhere.

TELEPHONE EXCHANGE SYSTEM.—Two patents were issued Dec. 4 to Alfred Stromberg and one to Alfred Stromberg and William M. Davis on a telephone exchange system. The first in date of application relates to telephone exchange systems in which common batteries are employed, and has for its object the provision of means for reducing the number of cord strands employed in connecting subscribers for conversation. The invention enables the connection of two metallic circuit telephone lines together in a telephonic circuit by a single cord strand, and the connection of the common battery with the telephone lines for the purpose of obtaining signals and for supplying the transmitters at the subscriber's station with current from the battery. One limb of each telephone line is permanently connected with one terminal of the battery, a line jack connecting with each of the remaining limbs of the metallic circuits; the cord and plug connecting apparatus employs a single cord strand and two connecting plugs, the line connecting apparatus at the exchange being so arranged that one side of the united telephone circuit between subscribers' stations is completed solely by the agency of the single cord strand, while the other side of the metallic circuit is completed by the two limbs of the subscribers' lines permanently connected with the battery. When subscribers are connected for conversation the battery is connected in parallel between the limbs of the united telephone circuit, that terminal of the battery which is not permanently connected with the limbs of the metallic telephone circuit being permanently connected with the single cord strand. Means are also provided whereby the apparatus used in connecting metallic telephone lines equipped in accordance with the present invention may also be employed in uniting an ordinary telephone line with a telephone line of this system. To this end a double contact plug is employed, and an extra cord strand leads from that terminal of the battery permanently united with the limbs of the metallic circuit lines, to the extra contact upon the double contact plug. A second patent has for its object the provision of an improved construction of switchboards involving an improved form and arrangement of spring jacks, whereby a much larger number of spring jack switches may be assembled upon each section of the board. Instead of horizontal extending frames or supports for the springs, a vertical support is used which affords a mount for a horizontal row of springs which may be closely assembled vertically and horizontally. These springs constitute line connections with spring jacks. A second vertical support is employed, containing metallic test thimbles in the case of multiple exchanges, from which metallic strips are extended toward the rear and anchored at the rear ends in the same vertical support that carries the springs, these metallic strips acting as electrical connections for the test thimbles, and also serving to unite two vertical members and to retain the proper distance between the same in order to secure proper alignment of the thimbles with relation to the switch springs of the multiple circuits and to form a firm integral structure. This construction enables the employment of but a single line spring in each spring jack, and enables each opposite section of the multiple board to be provided with about four times as many line spring jacks, thus greatly increasing the capacity of an exchange without taking extra space for the apparatus. The joint patent relates to means for providing an improved clearing-out annunciator that, after being operated, will be automatically restored upon the manipulation of the operator's apparatus. The magnet of a clearing-out annunciator is

associated with a cord circuit in such a way that it may be traversed by a current transmitted from the signalling generator operated at a subscriber's station which is connected with another through the agency of the cord circuit. The armature of the magnet when attracted serves to close a circuit including a battery or other source of current serving to maintain the clearing-out signal; this second circuit including the separable contacts of a switch controlled by the operator, which when operated serves to open this latter circuit and restore the clearing-out indicator to its normal idle condition.

AN IMPROVED DRY BATTERY.—A patent was granted Dec. 4 to Ernest Meyer, of Paris, France, on a dry battery, the novelty of which consists in the use of peat fibre or moss for retaining the exciting liquid in contact with electrodes. The depolarizing substance about the carbon rod is surrounded by a linen cloth which fulfills the purpose of a porous vessel. In the space between the cloth and the inner wall of the circular zinc plates there is inserted and compressed by means of a spatula, peat fibre or moss, which is then impregnated with the exciting liquid. It is stated that this vegetable material possesses properties which make it particularly valuable for use with dry batteries. Not only is its absorbing power very great, but it has the essential advantage over the cellulose heretofore used in dry batteries, of being absolutely neutral in the presence of the hydrated acids contained in the battery.

MECHANICAL CONTROL BY HERTZIAN WAVES.—A method of controlling mechanism by means of electromagnetic waves of high frequency is the subject of a patent granted Dec. 4 to Ernest Wilson and Charles J. Evans, of London, England. The system consists of a receiving mechanism having two receivers or coherers arranged at right angles to each other, in combination with an electromagnetic device for acting upon the mechanism to be controlled; and in the use of two transmitters arranged at right angles to each other for sending direct impulses to the opposite receivers. The receivers respectively respond to the movable transmitter when the same is brought into a plane approximately parallel to the plane of the receiver and when the part joining the centres of the two systems is approximately perpendicular to the planes of the transmitter and receiver. By this arrangement it is claimed that mechanism may be controlled at a distance by means of suitable electromagnetic connection with the receivers.

CURRENT INDICATOR AND AMMETER.—A patent was granted Dec. 4 to H. M. Warren which describes a current indicator especially adapted for use on electric railway cars or elsewhere where it is desired to know the number of times definite currents are sent through the instrument—for instance, on railway cars to indicate or record the number of times the motors take, say, 100, 200 and 300 amperes. The device may also be used as an ordinary ammeter. A core is contained in a cylinder which latter is surrounded by a solenoid, the whole being contained in a cylindrical case. The bottom of the central cylinder has a conical projection and the bottom of the core a corresponding conical cavity. The core floats in mercury contained in the central cylinder, and is counterbalanced by means of a counterweight connection on its stem. The current passing through the solenoid will have an effect upon the core depending upon the strength of the current, and with the indicator set to indicate a normal strength an increased or decreased degree would be indicated upon the dial as the core is drawn thereby down or let up.

IMPROVEMENTS IN TELEPHONES.—Among the patents granted Dec. 4 is one issued to Charles H. North on a telephone receiver, and another to Alfred Stromberg on a telephone transmitter. In the first mentioned, a telephone cup or head has a rim which engages the edge of the telephone shell. An annular permanent magnet lies within the head, and the binding screws are also carried by the same head. The expansion of the casing as a disturbing element is thus eliminated while the parts being all self-contained are easily adjusted in the first place irrespective of the casing, from which, moreover, they are easily removable. The Stromberg transmitter is designed to vary the resistance of the transmitter circuit without having the pressure between the electrodes varied. A stem secured to the centre of the diaphragm is jointed to a lever on one side of a fulcrum; the end of the lever on the other side of the fulcrum carries a rod, part of which passes into a receptacle containing granular carbon. The reciprocation of this stem set up by the diaphragm causes more or less of the commuted electrode to be engaged, thereby varying the resistance of the transmitter circuit.

LETTERS TO THE EDITORS.

Incandescent Lamp Measurements.

To the Editors of Electrical World and Engineer:

Sirs:—Generally it is not worth while prolonging the discussion of an engineering topic, since it so rapidly degenerates into dealing with matters either of a trivial sort or about which different people could be brought into agreement only by experimental demonstrations of the truth of one view or the other. And I feel that this is particularly true of discussions in the way of Letters to the Editors. But I am this time going to ask a little space in your next issue in which to reply to a letter in the number dated Dec. 1, signed by Mr. E. W. Cushing, mainly because in it this gentleman presumes to attack my professional sincerity in the presentation of a paper before the Franklin Institute on the general subject of incandescent lamp filament forms and the measurement of their candle-power.

My paper may have been "forensic rather than academic" (whatever that may mean), but Mr. Cushing is quite mistaken in saying that I brought the name of one company manufacturing incandescent lamps prominently into my paper. A hurried perusal of it would show that this is not the case. I mentioned but one company by name, and then only to render an acknowledgment to them for the idea upon which the whole paper was based. In a sort of supplement to the paper, I named one very special filament form just as I would name an Edison base or a T-H socket, by the name of the originator. It has been almost ridiculous to see how different manufacturers have assumed that this or that type which I showed was theirs; Mr. Cushing, for instance, seems to have a personal interest in some lamp which gives a very small "end-on" candle-power, indeed.

I almost wish now that I had not only specified types of filaments, but the manufacturers of each of the particular lamps I tested. I believe in giving people information in a paper, even if read before a dignified scientific society.

I am sorry that Mr. Cushing objects to the use of some of my paper by a manufacturer of lamps as advertising matter. I must remind him that this is the fate of a great many papers these days (even such as are more scientific than mine), and that *any* manufacturer of any type filament can reprint and use it, too, if he sees fit. It is certainly a pity that Mr. Cushing in his letter has chosen to so mix up items from my paper, Mr. Elliott's discussion of it, and from some trade advertising matter that it is almost impossible to tell which is which. I do not assume the responsibility for anything except what is in the *Journal* of the Franklin Institute, and what is published over my signature. Such questions as:

Who introduced the double coil filament, and how new is it?

What proportion of incandescent lamps are installed base upward or in a position such that the "end-on" candle-power gives the useful light?

What sort of illumination and light distribution is most desirable?

How useful a lamp would be which gave no "end-on" candle-power?

The relative advantages and disadvantages of double coil filaments in contrast with flattened coil filaments?

as well as some others the letter suggests, it is useless to try to discuss here. The only way Mr. Cushing and I could settle them would be to get together where we could talk, and then "have it out." We may be sure that these questions will all answer themselves ere long, as manufacturers of lamps can tell by any change in the demand for lamps of various types.

We must think of lamps (to use the expression of some one recently) not only as light producers, but as light distributors, too. Dr. Bell explains some of this difference, I am very much pleased to see, in that part of his serial on "Elements of Illumination" in the issue of Dec. 8. In your editorial comments in the same issue you emphasize the first quite too strongly, I think. One of the fundamental purposes of my paper, which has almost been lost in the discussion of "end-on" candle-power measurements, was to show that by changing the form of filament wonderful changes in the light distribution were produced, while among several lamps all rated at the same watts per candle-power (mean horizontal rating), the filaments might really be at quite different temperatures, simply because different filament forms were used.

ARTHUR J. ROWLAND.
DREXEL INSTITUTE, PHILADELPHIA.

Effect of Screening in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs:—I have noted the article on "Wireless Telegraphy" by a correspondent in the issue of Electrical World and Engineer of Nov. 17, and will say that my experiments on the subject do not quite bear out the theory advanced, as to screening and induction. In my work on the "Hertzian Waves" at the University of Minnesota, last May, the receiver used was of the aluminum wire single contact form, in circuit with a D'Arsonval galvanometer, and it responded to sparks from the Wimshurst machine, and also to sparks from the primary circuit of the induction coil. The oscillator used gave out extremely small waves 3 cm to 4 cm in length, and the interposition of a metal screen even as large as 4 ft. square did not stop the responding of the receiver to any of the above-mentioned sparks. The reflected waves evidently produced the effect. To obviate this effect, the coil and battery were enclosed in a thick galvanized iron box, but the cracks were sufficient to allow the waves to get out, and by reflection from the walls of the room to operate the receiver. The receiver and galvanometer were then placed in a metal box opened at the back and away from the oscillator; and reflection was still in evidence. In fact, it is almost impossible with a delicately adjusted receiver to overcome this. Grounding both boxes or screen did not obviate the trouble.

In order to see whether these phenomena are actually due to reflection, the experiments were carried on out in the open, and the interposition of a metal screen stopped the action of the receiver, whether the plate was grounded or not; while the same arrangement and spacing of apparatus in a room produces the reflection phenomena. Through careful experiments I came to the conclusion that the metal screen stops direct radiation, and if the receiver responds in this case it is due to reflection.

If the effects produced, as stated by your correspondent, are due to induction, why did not the more delicately adjusted receiver respond? The first explanation offered by the response of the receiver under the above-stated condition, was that of an inductive action on the metal screens; but later experiments convinced me that this was not so.

St. Paul, Minn. Hans W. Schmidt.

The Sticking of a Relay Armature When Bridged by a Condenser.

To the Editors of Electrical World and Engineer:

Sirs:—In the issue of Nov. 24 of Electrical World and Engineer, an article on the above subject by Walter O. Pennell appears. The author has very accurately described the conditions effecting the sticking of the relay. In fact, his description is so accurate, it seems strange that his conclusion should be amiss. He says, "If the condenser is removed and the armature pushed up, the sticking entirely ceases." This proves his claim that the phenomenon is not due to residual magnetism of the core. "If when the armature is sticking the condenser circuit be opened or the condenser short circuited the sticking will continue unchanged until the armature is pulled away from the contact, when it ceases." The data herewith quoted effectually disproves the author's conclusion and points quite forcibly to the fact that the contact points have been surface fused by the discharge of the condenser. A 2 or 4 microfarad condenser will give abundant proof of this fusion effect if connected with a large sized wire and short circuited with a nail. If the size of the wire, say, No. 12 copper, be decreased to No. 28 or No. 30, the fusion is reduced to a large extent. The introduction of anything like 10 ohms would very effectually reduce the fusion effect of the condenser discharge, which increases in potency as the resistance approaches zero.

H. W. Wilder.

To the Editors of Electrical World and Engineer:

Sirs:—I notice in the Electrical World and Engineer of Nov. 24, 1900, on page 808, an article by W. O. Pennell on "The sticking of a relay armature when bridged by a condenser."

Several things he mentioned do not conform with telephone relay practice in the Northwestern Telephone Exchange Company's apparatus. Three years ago, in a particular circuit, the sticking tendency mentioned by Mr. Pennell was noticed and effectually overcome by the insertion of one-half of a No. 8 repeating coil, about 110 ohms inductive resistance. Mr. Pennell mentions that "adjustments, capacity and other conditions" determine "more or less" the sticking quality. I found no compromise, it was a complete stick each time. Whatever adjustments, armature way back or relay tilted, or whatever capacity up to ten microfarads, proved equally deleterious in practice. In actual service, say, for two minutes, once pulled up, the armature stays up. Upon trial I found that one ohm inserted in the condenser circuit was just as effectual as 10 ohms, or 300 ohms, for a two-microfarad condenser, or five or ten of them. I found that it was not a case of saturation, nor was it one of bound charges, but a case of condenser explosion, as it were, or discharge, the spark of which welded the platinum contacts enough to retain the armature. The mischief is done at the beginning of the operation and not in the end of it. Mr. Pennell says, "As soon as the armature falls back an infinitesimal space, charges soak into the metal and the armature is retained by mere force of magnetic attraction." This seems entirely too fine and not acceptable at all to our practice. I find one ohm entirely sufficient for all practical purposes, and have numerous circuits working daily with no such trouble.

Minneapolis, Minn. J. C. Kelsey.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to several comments which appear in this and a previous issue on the above subject, I would say that the condenser discharge takes place when the armature contacts are closed, and if the trouble is due to a fusing of the contacts it starts from that moment. Experiments were made by first short-circuiting the condenser, then pushing the armature against its contacts, and finally opening the short circuit from the condenser. Under these conditions the sticking still persisted, although less frequently than before. The experiments were made not as carefully as I had wished, and I regret that I have not had the time to repeat them.

Mr. Kelsey in his letter states that the sticking was independent of adjustment and capacity, and that one ohm of resistance in the condenser leads was as effective as ten. I can only quote from my notebook the results of a considerable number of tests. With a 2-microfarad condenser about the contacts, in 100 trials, the armature stuck twice; with 4 microfarads, 10 times; 6 microfarads, 14, and with 10 microfarads, 30 times. In another case with 6 microfarads about the contacts and practically no resistance in the leads, in 50 trials the armature stuck 25 times. With a one-ohm coil in the condenser leads, the armature stuck 13 times; with 3 ohms, one time; with 5 ohms, one time, and finally with 10 ohms there was no sticking. Obviously when the tendency to stick is so slight any change in adjustment of the armature will have an effect. The contacts of the relay were of platinum.

Philadelphia, Pa. Walter O. Pennell.

Central Stations and Automobiles.

To the Editors of Electrical World and Engineer:

Sirs:—Apropos of the editorial upon automobiles in your issue of Nov. 24, I am prompted by the views you express therein to defend the position of many of the station managers to whom you offer the suggestion relative to purchasing an automobile for the purpose of securing personal valuable experience and for advertising purposes with the general public.

Not unlike many other station managers, I find myself very willing to become the owner of an automobile, but, first, the excessive cost of any of the recognized standard carriages; secondly, the limited distance for which the batteries can be used without re-charging, and, thirdly, the time necessary and the troubles incidental to re-charging the batteries—compel me to await with a considerable exercise of patience the evolution of some plan that will place the same within the means of what might be called a moderately well-salaried official.

I believe that a large majority of the central station managers are fully alive to the unusual benefits that result from the use of the automobile, but I think I am on perfectly safe ground in asserting that under the present method by which the would-be owner of an electric carriage is obliged to purchase the battery outfit, the introduction of the automobile will be a very slow process and will be almost wholly confined to the more or less wealthy class, as it has been in the past.

In order to popularize the automobile I believe that there should be some parent battery company that should own and control the

battery sets, and that should see that charging facilities are made available at every lighting and street railroad generating station throughout the country. The company should lease to any vehicle owner one or more sets as desired for a given amount per year and permit of an exchange of exhausted batteries for a re-charged set at any charging station, upon the payment of an established fee. Such a plan may offer many grounds for objection upon the part of the electric vehicle manufacturers, but until the question of securing fresh batteries without the delays that are now general and necessary it cannot be expected that the automobile will become very popular for either business or pleasure, as compared with the possibilities open under some such plan as above outlined.

As an illustration it might be said that the "Pianola" has only become a useful addition to the piano since the circulating library of music has been established and its introduction has been rapid since it has been possible to secure the music and frequent changes upon the payment of a yearly charge, even though both the instrument and yearly expense for music may be termed somewhat expensive.

WOBURN, MASS. L. R. WALLIS.

Cable Bulls.

To the Editors of Electrical World and Engineer:

Sirs:—I notice in your issue for Sept. 8 an editorial paragraph under the heading of "Bad Cable Operation." Upon this point let me give our experience.

A short time ago we received from a well-known firm in New York City a cablegram which puzzled us. After looking through all the codes, we asked to have it repeated. Even on a second trial, the cable people could not get it correct, but putting the first and second together we managed to decipher it. Below I give the message as originally filed, and as transmitted the first and second times:

As filed.	*First time.*	*Second time.*
Labastie	Redondait	Labastie
antehareo	anthabeo	antehareo
cadeazinha	cadeazinha	cadeazinha
Macbeth.	Macbeth.	Macreth.

If this is the best the Cable Company can do, I think it is further proof of the necessity of an American trans-Pacific cable.

At another time the Americans in this part of the world were astonished to read in the papers that a ship had gone ashore on Rhode Island in New York harbor.

We do not mind having astonishing news paragraphs set before us, but when it comes to such mutilation of important business messages, we think it is time that somebody "kicked."

BRISBANE, QUEENSLAND. J. S. BADGER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Slotted Armatures.—DETTMAR.—A very long illustrated paper "On the distribution of the lines of induction with slotted armatures for direct and alternating current machines." He refers to the well-known fact that the iron losses, found from the power at no load, are always considerably greater than the losses predetermined by calculation, generally by 150 to 200 per cent, but even sometimes by 350 per cent. He says that this difference is mainly due to the losses in the magnet iron, which are generally assumed too small. In the first part of the paper he deals with the calculation of the iron loss in the armature core and shows that mistakes are often made in such computations. He distinguishes between the following three methods of calculation: In the first method the calculation is based upon the supposition of an average flux density, found from the number of lines of induction and cross section of the armature core in Fig. 1.

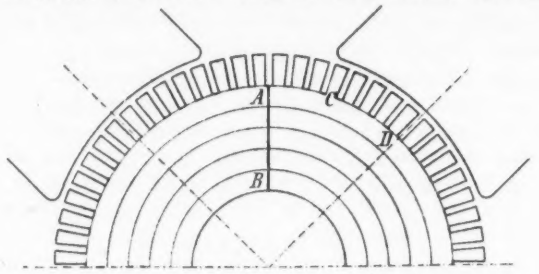


FIG. 1.

The second method is a modification of the first, in which the non-uniform distribution of the flux, due to the different lengths of the lines, is taken into consideration. The third method takes into consideration that at the foot of the slots, at the place *C D*, there is a different flux density than at the place *A B*; the calculation is based upon the maximum flux density to which any part of the armature core may be subjected. The results obtained by the first and second methods differ only slightly by ½ to 1½ per cent. With the third method he obtains considerably greater values of the armature loss; he finds that with this method it is not necessary to take the non-uniform distribution of the flux into consideration, as the exactness of the calculation is thereby increased only slightly. He applies the third method in the following way: The armature core is divided into a number of concentric rings of equal width; he shows that four or five are sufficient; in Fig. 1 five such rings are shown. The average flux density of each ring is found by a graphical method. Fig. 2 gives the induction at all points of the armature for a certain machine; the abscissa represents the position of an element of the core in such a way that the core thickness 0 and 1 in Fig. 2 correspond to the points *A* and *B* in Fig. 1; the ordinate gives the maximum induction to which the element is subjected at any place. From this curve the average induction of each ring can be found. He gives the results of tests of four machines to which he has applied his method of calculation; by his method the differences between measured and calculated iron loss become much smaller than with the older method of calcu-

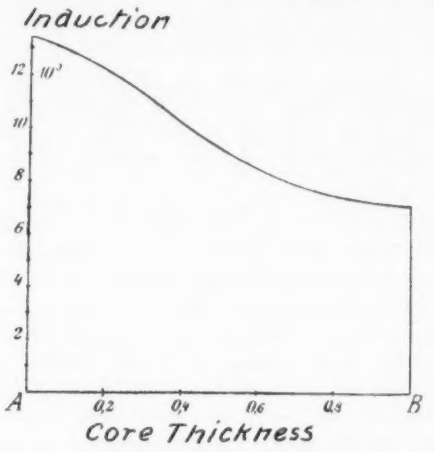


FIG. 2.

lation. He shows the incorrectness of Niethammer's assertion that this difference between measured and calculated loss is due to the fact that the hysteresis loss per magnetic cycle is different, depending on whether the value of *H* is varied or whether the iron core is revolved in a constant magnetic field. The shows that Niethammer does not take into consideration the loss in the magnet poles. The second part of his paper deals with the distribution of the flux in the magnet poles. In the part of the pole, opposite to the armature, there is a non-uniform distribution of the flux, on account of the slots. He endeavored to investigate this experimentally, and describes an interesting method, in which he got pictures of the distribution of the flux on the surface of the pole by means of iron filings. He made such experiments with three direct-current machines and on a three-phase alternator. The pictures obtained with two old machines, in which the air-gap is too small compared with the breadth of the slots, show the non-uniformity of the distribution of the flux very clearly, while the picture obtained with a machine of recent design shows the

non-uniformity only slightly. The main result appears to be that, in all machines investigated by him, the distance between the ends of the armature teeth and that zone in the magnet pole where the distribution of the flux becomes uniform in the magnet poles, is about twice the breadth of the slots. He has tried to apply his results to calculating the iron loss in the magnet system, but the values obtained are much too high, if the screening action is not taken into consideration, which is impossible at present. He shows some other methods, by which practical formulas for the calculation of the magnet iron loss may be obtained; one is based upon the fact that the processes in eddy current brakes are very similar to those in the poles.—*Elek. Zeit.*, Nov. 15.

Overcoming the Vibrations Caused by Motors.—Cowper-Coles.—An illustrated article on means for running motors and dynamos in upper floors of buildings without causing any noise and vibration. He tried felt, rubber buffers, and washers, cork, and felt interleaved with lead; he also placed the motor on a thick bed of sawdust or coffee husks or some similar soft and comparatively elastic material; but none of these methods were found to entirely remove the nuisance. Placing the motor on springs was found to be entirely satisfactory; the machine was not bolted to the floor, but the wood frame on which it was placed was merely allowed to rest on the springs, suitable recesses being cut to prevent lateral movement.—Lond *Elec. Rev.*, Nov. 23.

REFERENCES.

Contributions to the Calculation of Dynamos and Motors.—Niethammer.—A long, illustrated French abstract of the German paper, noticed in the Digest Aug. 4.—*L'Eclairage Elec.*, Oct. 20.

Induction Motors.—Burchi.—An illustrated article on the design of alternating-current motors for given conditions. He discusses by means of diagrams how to get a high starting torque and a high power factor in an induction motor.—*L'Eclairage Elec.*, Oct. 27.

Induction Motors.—A brief illustrated description of what is said to be the largest induction motor in the world. It is a 1000-hp motor of Brown, Boveri & Co., directly connected to a centrifugal pump in the municipal pumping plant at Geneva. The motor weighs 27 tons and runs at a speed of 544 r. p. m.—*West. Elec.*, Dec. 1.

Synchronous Converters.—Parshall and Hobart.—The following articles on the synchronous converter: A paper on its principle, especially on the ohmic losses in the converter. Lond. *Eng'ing*, 1899, Sept. 29.—A paper on the general design of synchronous converters with numerous diagrams of various kinds of windings; they discuss the three-phase converter and the increase of output by the use of six slip-rings. *Eng'ing*, 1899, Oct. 22.—A discussion of the interconnection between transformers and synchronous converters. *Eng'ing*, 1899, Oct. 27.—A paper on the design of a six-phase converter. *Eng'ing*, 1899, Dec. 8.—All abstracted in *Brit. Inst. Civ. Eng., Abstracts*, v. 142, pt. 4.

Winding Coils.—Loewit.—A translation in abstract of the German article, noticed in the Digest Nov. 17.—Lond. *Elec. Eng.*, Nov. 23.

Lights and Lighting.

Arc Lamp.—A brief illustrated description of the Gilbert focussing lamp of the clutch type, the clutch being of a new form. There is no rod attached to the upper carbon. A double carbon open arc holds 6 ft. of carbon and burns 50 to 80 hours; the controlling gear consists of double solenoids with U-shaped cores; there is no other feeding mechanism; notwithstanding the large amount of carbon in the lamp the whole lamp is shorter than the usual form.—Lond. *Elec. Rev.*, Nov. 23.

Power.

Cost of Electric Power in Copenhagen.—Hentzen.—An article giving some information on the cost of driving electric motors in various works, supplied with current from the Copenhagen central station. The present price is 4 cents per kw-hour. At present there are some 325 motors connected to the mains. For driving elevators and hoists the yearly cost has averaged $9.75 per horse-power, rising in one instance to about $55. In printing works the annual cost of horse-power averages $34.75, in one case it is $55, while in a number it is below $27.50. Woodworking, spinning and weaving machinery, and smaller factories average $36.25, a few run up to $55 and $82.50, while a great many are below $27.50. Small motors of about one-half horse-power are in favor for working coffee mills, and pay from $27.50 to $110, averaging $55 per annual horse-power.—*Ingenioren* (Copenhagen), 1899, p. 229; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 142, pt. 4.

Fuel Consumed per KW-Hour.—Meyer.—A table showing the weight and cost of fuel, consumed per kw-hour in 18 German and Swiss electric plants, driven with power gas or steam. It appears that for smaller plants the use of power gas is at least not more expensive than that of steam, and that for such plants, if only the cheapness of the power is considered, power gas may be used to advantage.—*Elek. Zeit.*, Nov. 15.

Engine Without Governor.—Griggs.—An illustrated description of a "method of using engine without governor on electric lighting circuit of several branches." This may be done in case a governor is broken and it is necessary to lash the broken governor fast in such a way that it allows the engine to take full steam and then run the engine by throttle. His device is for the purpose of preventing an accident when a short-circuit occurs on one of the mains and the engine speeds up. This is done by a water rheostat in the field rheostat circuit. When a short-circuit occurs on one of the mains, a fuse wire is blown and one of the electrodes of the water rheostat is automatically removed and the field circuit is broken.—*West. Elec.*, Dec. 1.

Electricity in Mines.—Liebert.—A summary of the applications of electricity to mining machinery that have been made in Belgium up to the present time for lighting, hoisting, pumping, and hauling. In the larger number of cases direct current at 500 to 650 volts is used, but in the district east of Liege three-phase alternators have been adopted, the voltage being about 500 in the first installations and 2000 in the newer ones. In some mines about 2000 Sussman's portable lamps, which were noticed before in the Digest, are used; the lamps are supplied by a Belgian company at a rent of $0.45 per lamp per month, the cost of energy consumed is below $2.50; the cost of labor in filling, cleaning, etc., is $4 per 1000 lamps per day; these figures on the basis of 25 working days per month, give a total cost per lamp of about 2.3 cents per day of 11 hours.—*Bull. de la Soc. de l'Ind. Min.*, v. 14, p. 87; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 142, pt. 4.

Lifting Apparatus.—Egger.—A long and well-illustrated paper in which he describes in detail the lifting apparatus used on a station of the Vienna Street Railway for lifting cars of 66,000 lbs. 20 ft. in 1¾ minutes. Shunt motors with a normal power of 40 horse-power at 800 r. p. m. are used, with a high starting torque, the difference in speed between no load and full amounting to not more than 4 per cent. The controller is described in detail.—*Zeit. fuer Elek.*, Oct. 28, Nov. 4.

REFERENCES.

Mechanical Applications of Electricity.—Richard.—Brief illustrated descriptions of some new mechanical applications of electricity; a compressor of the Standard Air Brake Co.; a series motor of the Storey Motor Tool Co.; a pressure regulator of Christensen; devices of Kaye and Valentine for stopping steam engines; a device of Batchelor for the electric operation of valves; a method of Harfield for electrically operating the rudder of a ship; a portable drill of Hohn; an electric riveter of Kodokitsch, and a ventilator of Lundell.—*L'Eclairage Elec.*, Oct. 27.

Electric Rock Drill.—Cuvellette.—An article on the Dulait-Forget electric rock drill, which is a percussion drill driven by a 1½-hp direct-current motor taking 14 amperes at 110 volts. Some information is given about the working of the drill and the cost and rate of driving per week in different classes of rocks.—*Bull. de la de l'Ind. Min.*, v. 14, p. 161; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 142, pt. 4.

Blast Furnace Gases.—Donkin.—An illustrated paper on motive power from blast furnace gases. He discusses the difficulties which first seemed to prevent the use of these gases, and how they have been overcome, and gives a brief history of the work done in this respect in Scotland, Belgium and Germany. He has seen many plants running, and is of the opinion that there is a great future for these gases, especially for large power gas engines.—*Eng. Mag.*, December. A paper on the same subject, by Gordon, is abstracted in the same issue from *Iron Age*.

Motors for Printing Machinery.—An illustrated article on the Ward Leonard system of operating printing machinery by electric motors.—Lond. *Elec.*, Nov. 23.

Traction.

Automobile Competition.—O'Gorman.—An article giving some notes on the electric automobile trials held by the Automobile Club, as noticed in the Digest Dec. 8. The conditions were rather severe; the roads had many grades and were very bad. The well-known accumulators made by the great storage battery manufacturers were entirely unrepresented; each car maker or owner ran his own cell.

With few exceptions, no trouble was anticipated or occurred in the motors or control. Some information is given about several of the automobiles. A Krieger automobile contained 60 Lecoll accumulators, with deposited zinc negatives and lead peroxide positives in a porous pot; the capacity is 270 amp.-hours. "There is but little information available in regard to lead-zinc batteries. The 25 per cent increase in e. m. f. is a clear gain. The dissolution of the zinc, even when amalgamated, on open circuit is a countervailing disadvantage which appears to have been gotten rid of at any rate in Regnier's battery by Werner's use of cadmium sulphate in the electrolyte together with a little magnesium." Reference is made to results, formerly published, showing that "with pure zinc sulphate the lead positive was not fully peroxidized; with cadmium sulphate the watt-hour capacity was diminished, but the addition of magnesium sulphate to both the other sulphates for some unexplained reason restored the balance and gave good results. The exact procedure in the Lecoll battery is not yet published, but it apparently does not attempt to obtain the 16 watt-hours per pound of total cell claimed for Werner's accumulator." Some of the controllers divided their battery into a large number of small units in parallel for hill work; this device, useful at first, is most pernicious after the cells have had a little rough usage, on account of heavy balancing currents caused when the voltage of some of the cells gets lower than others.—Lond. *Elec.*, Nov. 23. Another (anonymous) article on these automobile trials in Lond. *Elec. Rev.*, Nov. 23.

Storage Battery Cars.—ANDREAS.—The first part of an article on the different methods used in placing a storage battery in an automobile or in a tramcar. He first gives the reason why in heavy cars with heavy battery, as in the accumulator cars of the tramways of Berlin, Dresden, Halle, the battery is generally permanently attached to the car, and cannot be replaced as a whole. He briefly discusses the different methods by which the plates are suspended and insulated from one another; for practical reasons he prefers to insulate the plates by means of felt, etc., instead of by means of glass rods; a grate of ebonite seems still better. For the battery box he prefers ebonite. Celluloid should never be used on account of the great danger of fire. —*Centralblatt fuer Accum. und Elem. kunde,* Sept. 15.

Electric Traction on Canals.—An editorial referring to the experiments made by Siemens & Halske on the Finow Canal, which were mentioned before in the Digest. The real essence of canal traffic in a country well supplied with railways is its cheapness. Were electric propulsion or traction to be adopted, only a comparatively small increase of speed would be generally practicable. If a lighter and more durable storage battery would be invented, this would yield the best electrical system. Otherwise something in the nature of a trolley wire is essential; there are two systems possible; either electric traction, where the motor actuates a towing locomotive outside the canal vessel and placed either on the towpath or on a suspended wire; or electric propulsion where an electric motor is to propel a vessel by the action of a screw or other form of propeller on the water. With the latter system a higher speed could be obtained, but this would increase the agitation of the water and the wash against the canal banks. It is said that the adoption of electric tow boats, propelled by means of screws of a pitch that would adapt a high speed motor to a slow speed barge, seems simpler, and its initial cost lower than the Siemens & Halske method with a locomotive on the towpath.—Lond. *Elec.*, Nov. 23.

Sydney.—WEBB.—The conclusion of the illustrated article on the electric tramways in Sydney, N. S. W., noticed in the Digest Dec. 1. The total length of track on all the Sydney tramway systems consists at present of 39 miles 28 chains of double track and 17 miles 65 chains of single track. Of these, 10 miles 54 chains of double track and 9 miles 15 chains of single track are now operated electrically, and by the end of the year it is anticipated that there will be a further addition of 6 miles 56 chains of double track and 4 miles 61 chains of single track.—Lond. *Elec. Rev.*, Nov. 16.

Tramway Working Costs.—Tables showing the receipts and working expenses on the Leeds City tramways for electric, steam, and horse cars during the last year. The total mileage was 1,205,812 for electric; 468,760 for steam, and 990,182 for horse cars. The receipts per mile were 25.24, 24.26, 19.14 cents; the working expenses per mile were 11.94, 23.8, 21.54 cents; the latter figures do not include interest on capital and sinking fund, or depreciation on electric plant other than cars.—Lond. *Elec. Rev.*, Nov. 23.

REFERENCES.

Three-Phase Traction.—REICHEL.—A very long, illustrated French abstract of his German paper on trials of Siemens & Halske, which was abstracted in the Digest June 30.—*L'Eclairage Elec.*, Oct. 27.

International Tramway Congress.—Continuation and conclusion of the account of the proceedings of this congress, with abstracts of the following papers: Van Vloten, "Power Distribution for Electric Railways" (Digest, Nov. 24); Fischer-Dick, "The Falk Joint"; Broca and Johannet, "Accumulator Traction" (Digest, Nov. 24); de Burlet, "Heating of the Cars."—*L'Eclairage Elec.*, Sept. 22; Ziffer, "Operation of Secondary Railways"; Macloskie, "The Rating of Motors"; Monmerque, a brief note on "Brakes."—*L'Eclairage Elec.*, Sept. 29. Translations in abstract of the papers of Broca and Johannet, Ziffer, de Burlet, Van Vloten and Macloskie in *St. R'y Jour.*, Nov.

Automobile Tests.—KALLMAN.—Continuation and conclusion of his full report on the results of the competitive tests of electric automobiles in the spring of 1900 in Berlin, the first parts of which were noticed in the Digest Nov. 24, Dec. 8. A summary of the results was given in the Digest Nov. 17.—*Elez. Anz.*, Nov. 15, 22.

Automobiles.—An illustrated description of different types of electric automobiles built by Scheele.—*Centralblatt fuer Accum. und Elek. kunde,* Oct. 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Installation at a Country Seat.—A long, illustrated description of the private installation of Ardross Castle, Ross-shire. It is entirely dependent upon water-power and use has been made of electric heating. The lamps, motors, heating apparatus, etc., are in all equivalent to some 3000 lamps of 8 candle-power. Two exactly similar sets of 25-hp turbines and dynamos are in use, one being sufficient for all ordinary requirements. The dynamos are direct connected to the turbines and run at 1200 r. p. m.; the turbines are provided with centrifugal governors, regulating by hydraulic means the admission of water to the wheels by opening and closing the guide blades. The dynamos are overcompounded and give 80 amperes at 220 volts. No storage battery has been installed. The lighting of the ballroom and dining-room is noteworthy. Some 26 bedrooms, as well as sitting, linen, and brushing-rooms, are fitted with electric radiators, which have proved most valuable in the saving of labor in cleaning fireplaces and in the carrying of coals; the saving of coal is also considerable. The new church is lighted and heated by electricity. At the farm a 15-hp motor has been installed for driving the farm and estate machinery. For general lighting purposes one dynamo is sufficient, but when heaters or motors are brought into use, the load runs up to 150 amperes; as the man in charge is not constantly in attendance at the turbine house, automatic arrangements are used to start the second turbine and couple it to the mains when the load on the running dynamo exceeds 80 amperes. Some load curves are reproduced.—Lond. *Elec. Rev.*, Nov. 23.

Electricity Supply.—An abstract of the discussion which followed the paper of Chamen (Digest, Dec. 8). Most of the speakers agreed with Chamen that direct current is the most satisfactory supply for a consumer. Sayers said that until recently difficulties of commutation made it impracticable to work a direct-current motor at anything below its normal excitation without loss of power and destruction of the commutator, but recent improvements had rendered it possible to vary the speed of a motor. Pickstom said that for printing and like work it is possible to get a range of speed from zero to full speed at good efficiency. Other speakers discussed the choice of pressure.—Lond. *Elec.*, Nov. 23.

Charging for Electricity.—BOOT.—A brief communication on the comparative cost of 110-volt and 220-volt supply in Tunbridge Wells. When supplying at 110 volts, they were charging on the basis of the "number of lamps installed"; during the winters quarters a consumer had to use 8 units per 8-cp lamp installed per quarter, and during the summer quarters 2 units per candle-power, making in all 20 units per 8-cp lamp per year to be charged at 12 cents; any units over and above were charged at 6 cents. With the 220-volt supply they are charging on the maximum demand basis, the price being 12 cents for the first hour and 6 cents afterwards. He gives in a small table six instances showing the average price obtained when charging by these systems during two years; in the three first quarters of the year the price is nearly the same with both systems, while in the last quarter of the year the price is considerably less with the maximum demand system at a 220-volt supply.—Lond. *Elec. Rev.*, Nov. 23.

REFERENCES.

Choice of System of Electric Supply.—BULL.—A very long discussion of the choice of a system of electric supply for different purposes. He discusses the choice of the generators, the switchboard, transformers, the use of storage batteries, and the use of motors for different purposes.—*Teknisk Ugeblad* (Christiana), 1899, p. 470, and 1900, p. 4.—Abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 142, pt. 4.

High Pressure Regulations.—A reprint of the extra regulations issued by the British Board of Trade for the new extension scheme of the Manchester corporation supply, where for transmission a voltage of 6500 is to be used, which comes under the category of "extra high pressure."—Lond. *Elec.*, Nov. 23.

English Central Station.—Perkins.—An illustrated article on central station practice in England, shown in the concrete example of the St. Luke's and Wandsworth stations of the County of London Electric Lighting Co., which were noticed before in the Digest.—*Eng. Mag.*, December.

Zurich.—A brief illustrated description of the three-phase current plant of Zurich.—*El'ty*, Dec. 5.

Wires, Wiring and Conduits.

Aluminum Soldering.—King.—A brief communication stating that a firm of optical instrument makers in England got from the United States a sample of the solder invented by Prof. Richards, and "for the first time have been able to successfully solder aluminum. This metal may now become extremely useful."—Lond. *Elec. Rev.*, Nov. 23.

Paper Insulation.—Rabinowicz.—A long article on "The use of cellulose in the form of paper in electrical engineering." He gives a history of the use of paper for the insulation of transmission lines and discusses paper insulation of telephone wires. While the capacity of telephone cables made with gutta percha is 0.24 microfarad per kilometer at 15 degs. C. and 0.07 microfarad with an insulation impregnated with paraffine, it is only 0.05 to 0.03 microfarad with the use of paper and air as dielectrics.—*Elek. Zeit.*, Nov. 15.

REFERENCES.

Variation of Potential and Current on Long-Distance Alternating Current Lines.—Breisig.—A long illustrated French abstract of the German paper noticed in the Digest Feb. 24.—*L'Eclairage Elec.*, Oct. 27.

Electric Mains.—The first part of a serial, by "a mains engineer," giving "Practical notes on electric mains." This part is of a non-technical character and gives some general notes, especially on the management of men.—Lond. *Elec. Eng.*, Nov. 23.

Electro-Physics and Magnetism.

Atmospheric Electricity.—Liebenow.—A long paper read before the Electrotechnical Society of Berlin. From the measurements of the potential gradient by Le Cadet, he calculates the distribution of the free electricity in the atmosphere. He finds that the total charge of the surface of the earth is about 300,000 coulombs of negative electricity. The same quantity of free positive electricity is distributed in the atmosphere, mainly in the lower kilometers of the atmosphere; the free electricity decreases very rapidly with the height above the surface of the earth; at a height of 10 kilometers the unit volume of air contains only 2 per cent of the quantity contained in the same volume at the surface of the earth. The difference of potential between a point on the surface of the earth and a point outside of the atmosphere is about 164,000 volts. He then endeavors to give a new theory of the origin of atmospheric electricity, based upon his theory of thermoelectricity (Digest, July 29, 1899; April 21, 1900), and upon the fact that the air is colder at higher than lower portions of the atmosphere, so that there is a heat current in the atmosphere upward. He applies the same principles to an explanation of the origin of electricity in thunderstorms and deals at some length with the theory of the aurora polaris.—*Elek. Zeit.*, Nov. 15.

Coherer.—Popoff.—The first part of a paper on "Apparatus for the detection and registration of electrical vibrations." After a brief review of the history of the coherer he describes a form which he has found suitable for lecture experiments and for recording the electrical disturbances in the atmosphere. He agrees with Lodge that the coherer phenomenon "is a singular variety of electric welding." His coherer consists of a glass tube inside of which are pasted two strips of platinum foil; one foil is brought out to the external surface from one end of the tube, and the other from the opposite end; the inner ends of the foils do not extend to the corks which close the tube; the tube, when in use, is placed horizontally so that the foils are in its lower half and the metallic powder covers them, the tube being, however, filled only half full. The best results were obtained with a sort of iron powder. He also describes experiments in which he substituted small shot or powdered antimony for the filings.—*Russian Phys. and Chem. Soc'y's Jour.*, January; the first part is translated in Lond. *Elec. Rev.*, Nov. 23.

Torsional Magnetostriction.—Barns.—A preliminary paper on "Torsional magnetostriction in strong transverse fields and allied phenomena." He describes a model which illustrated dynamically the phenomena in question; also his method of experimenting, including the results of the experiments made step by step. He found that the "effect of longitudinal magnetization is an increment of rigidity in all paramagnetic metals; whereas the permanent effect of a transverse or a circular field is relative inappreciable so far as rigidity is concerned." The quantity which he considered here is the permanent effect of magnetization on rigidity, i e., that which perisists after making and breaking the field many times. Another paper will deal with a very striking temporary effect of marked relative value.—*Am. Jopr. of Science*, December.

REFERENCES.

Alternating-Current Problems.—Goldschmidt.—A mathematical paper on approximate solutions of certain alternating-current problems. The first deals with the non-uniform distribution of the current in a conductor and the so-called skin effect; the second with the eddy currents in sheets and masses of iron; the third with the distribution of the current in armatures of the squirrel cage type. The paper is purely mathematical and cannot be abstracted.—*L'Eclairage Elec.*, Oct. 13.

Alternating Currents.—Goldsborough.—In the continuation of his serial he gives a further example of the relation between the waves of the e. m. f. induced in an armature wire of an alternator and of the magnetic field through which it cuts. He then begins to discuss the current produced by an alternating e. m. f. in a circuit containing resistance and reactance.—*Elec. Rev.*, Nov. 28.

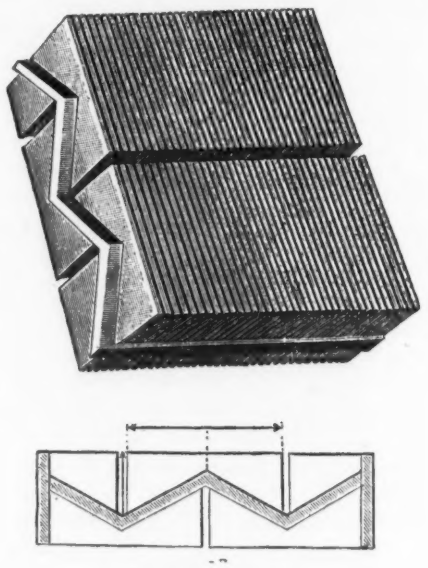
Skin Effect.—Herzog and Feldmann.—A translation in abstract of the general paper, noticed in the Digest Nov. 10.—Lond. *Elec. Eng.*, Nov. 23.

Coherers.—Righi.—A longer abstract of his Internat. Phys. Congress paper, noticed in the Elec. World and Eng., Sept. 8, p. 378.—*Sc. Amer.*, Dec. 1.

Magnetic Rotary Polarization.—W. Wien.—A note in which he replies to a former criticism of Brillouin, who had claimed the incorrectness of Wien's statement that the magnetic rotation of the plane of polarization is an exception of the theorem of Clausius. He adheres to his former statement and explains it.—*L'Eclairage Elec.*, Oct. 20.

Electro-Chemistry and Batteries.

A New Plante Plate.—Weber.—An illustrated description of a new Plante plate, used in the Omega storage battery of Geoffrey and Delose. The plate is used only as positive electrode. The principal feature is the form of the core of the plate; its cross-section is not a straight line, but a zig-zag line; on both sides of this core plates are mounted, as shown in the adjoining figure; the arrangement is such



NEW PLANTÉ PLATE.

that each plate is enabled to expand in any direction, so that buckling is prevented. A special process of formation is used, which requires only three days, although no chemicals are used which can be detrimental later; this process is not described.—*Centralblatt fuer Accum. und Elem. kunde*, Oct. 15.

Primary Battery.—SWINGLE.—A brief description of one which is said to have attracted considerable attention, invented by Spahr, who claims to have discovered a new electrolyte, but what it is is not described. The air is said to be used as the depolarizing agent; the "fluid" is introduced in the cell from the bottom drop by drop, so as to enable the air to be gotten into the cell. 18 cells (size not given) run a 2-hp motor; the weight of 18 cells complete with reservoir for a 12 to 14-hours' run, was a little over 100 lbs.—*West. Elec.*, Dec. 1.

Calcium Carbide.—J. B. C. KERSHAW.—An article calling attention to the fact that the cost of electrical energy is the chief factor in determining the cost of carbide production, and that it is, therefore, important to obtain the highest possible electrical efficiency in the furnace. He gives seven different calculations, by different authors, of the theoretical yield of carbide furnaces; according to them the kw-hours, theoretically necessary to produce 1 metric ton (2204 lbs.) of calcium carbide containing 80 per cent carbide, are 1523, 1941, 1960, 2043, 2640, 2670, 3069, 3290, 3293. These are so different that the results are evidently based in some cases upon incorrect data. He remarks that the sources of error in such calculations are numerous and that they are at present of little value. He reproduces the calculation of Gin, who has obtained the figure 3069 in the above list. —Lond. *Elec.*, Nov. 23.

Electrolytic Bleaching.—HESS.—A brief preliminary note on a new electrolytic bleaching installation in Billingfors, Sweden. For the bleaching of 14 tons of cellulose daily 1760 to 1850 lbs. of chlorine are required, which are produced with 390 horse-power from 5.6 tons of Stassfurt rock salt. The bleaching solution, running off from the electrolyzers, contains 14 to 15 grams of active chlorine per litre. The cost of the production of this quantity of chlorine for the power, including interest, repairs, and amortization, the salt, wages, is about $50.—*Zeit. fuer Elektrochemie*, Sept. 6.

Rotation of Electrolytes in Magnetic Fields.—URBASCH.—An illustrated paper in which he tries to connect the modern views of the electrolytic theory of ions with Maxwell's theory of the electromagnetic field. When an electrolyte, through which a current is flowing, moves under the influence of a magnetic field, he explains the action by the assumption that the traveling ions produce a new magnetic field, which, acted upon by the given magnetic field, causes the motion of the electrolyte. That traveling ions can produce a magnetic field, is in accordance with experiments showing that moving static electricity influences a magnet like an electric current. He describes some interesting experiments, one of which is the following: In a small glass basin two electrolytes are placed one above the other, the basin is placed in a strong magnetic field, the lines of force diverging like the rays of a cone; the electrolytes are then seen to rotate; the rotation lasts as long as there can be observed a separation of the two electrolytes; the direction of the rotation depends upon the direction of the magnetic flux and also upon the nature of the electrolytes.—*Zeit. fuer Elektrochemie*, Sept. 6.

Notation of Electro-Chemical Units.—A summary of the notations which Hollard has recommended to the Internat. Elec. Congress for electro-chemical units.—*Zeit. fuer Elektrochemie*, Sept. 20.

A summary of the notation recommended by Le Blanc before the Internat. Congress for Applied Chemistry.—*Zeit. fuer Elektrochemie*, Oct. 11. In agreement with Le Blanc's suggestion, the German Electrochemical Society has resolved that in publications on electric conductivity the notation of Kohlrausch and Holborn in their book on the conductivity of electrolytes, should be used.—*Zeit. fuer Elektrochemie*, Oct. 25.

REFERENCES.

Nernst Theory of the Galvanic Cell.—ROTTE.—An account of measurements made with the capillary electrometer and said to be striking verifications of Nernst's theory of the e. m. f. of a galvanic cell.—*Jour. de Physique*, October; briefly abstracted in Lond. *Elec.*, Nov. 23.

Solution Pressure.—LEHFELDT.—An abstract of a British Phys. Soc'y paper on "Electromotive force and osmotic pressure." It is mainly an attempt to explain a difficulty which he has found in Nernst's formula for the e. m. f. between a metal and a solution.—Lond. *Elec.*, Nov. 23.

Dissociation Theory.—NOYES and BLANCHARD.—A description of seventeen striking lecture experiments illustrating the electrolytic dissociation theory and the laws of the velocity and equilibrium of chemical change.—*Jour. Am. Chem. Soc.*, v. 22, p. 726; briefly noticed in *Am. Jour. of Sc.*, December.

Transference Number.—GRUENEISEN.—A correction of a mistake in the paper of Kendrick, noticed in the Digest Sept. 1.—*Zeit. fuer Elektrochemie*, Sept. 20.

Electro-Chemical Reduction.—ELBS.—A paper of a highly chemical character on the electro-chemical reduction of certain aromatic substances in a slightly alkaline solution.—*Zeit. fuer Elektrochemie*, Sept. 20, 27.

Reduction Processes.—ELBS.—A brief illustrated description of a method of investigating electrolytic reduction processes by measuring the unused hydrogen which escapes at the cathode.—*Zeit. fuer Elektrochemie*, Sept. 6.

Stirrer.—LOEB.—An illustrated description of a stirrer which may be used to advantage for electrolytic processes requiring energetic stirring during the measurement of the escaping gases.—*Zeit. fuer Elektrochemie*, Sept. 6.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Alternating Current Measurements.—CAMPBELL.—Three Brit. Phys. Soc'y papers. In the first he describes a "phase turning apparatus" for use with electrostatic voltmeters; electrostatic voltmeters are particularly insensitive at the lower parts of their ranges; therefore when measurements of small direct current potential differences have to be made, it is best to add a constant voltage large enough to bring the deflection to an open part of the scale; for small alternating current voltage measurements the auxiliary voltage must have the same frequency and be in phase with the voltage to be measured; the apparatus described enables the phase of the auxiliary voltage to be turned until it agrees with the one to be measured; the method is to get two independent equal voltages u and v, differing in phase by 90 degs., and to add together suitable fractions of these such as $u \sin \phi$, $v \cos \phi$; the resultant is u, but with the phase turned through ϕ the unknown small voltage is connected in series with an auxiliary voltage and a voltmeter, and the phase of the latter voltage is turned until the maximum deflecion is obtained. In his second paper he describes a method of measuring power in alternating current circuits; the circuit in which the power is to be measured is connected across the supply circuit in series with a small non-inductive resistance; by means of a transformer the small voltage on this resistance may be transformed into one whose phase is 180 degs. behind the voltage on the resistance; this is added to the voltage on the circuit to be measured, and then reversed and added again; the difference of the squares of these effective resultants is shown to be equal to a constant into the power to be measured; if there is any direct current, it must be measured separately by a Weston voltmeter or other suitable instrument. In a third paper he gives a note on obtaining alternating currents and voltages in the same phase for fictitious non-inductive loads, when testing instruments for the measurement of large amounts of electric power or energy; the current for the instrument under test is got by means of a transformer worked on a 100-volt circuit; the potential difference in the same phase is got by allowing the current to flow through a non-inductive resistance, and increasing the voltage at the ends of the resistance to the required amount by means of another transformer.—Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Nov. 23.

Testing Thermocouples.—LINDECK and ROTHE.—A description of the method used by the German Reichsanstalt for testing thermocouples intended for pyrometric work. The chief innovation in the testing arrangement is an electric oven, consisting of four concentric porcelain tubes, only the outermost of which is glazed and covered with asbestos. The inner tubes are made of a very refractory material devised by Hecht. For temperatures up to 1400 degs. the second tube is wound with a 2 mm. pure nickel wire, prevented from oxidizing by covering it with fire-clay paste. For still higher temperatures the wire used for heating is a platinum-iridium wire, by means of which a temperature as high as 1600 degs. can be attained. When that temperature is exceeded the wire fuses into the porcelain. The temperature can be regulated with great rapidity and precision, the fine regulation being made by means of a sliding contact on a constantan band. The power consumed is 60 watts at 200 degs. and 1540 watts at 1300 degs. A number of couples are tested simultaneously by means of a compensation method, the junctions being held by friction in a small circular piece of platinum-iridium. The errors of the measurements do not exceed 0.1 per cent.—*Zeit. fuer Instrumentenkunde*, October; abstracted in Lond. *Elec.*, Nov. 23.

Quadrant Electrometer.—CHAUVEAN.—A paper on the fact that in measuring high potentials with the quadrant electrometer, whose sensitiveness is reduced by the use of a heavy needle and a consider-

able distance between the wires of the bifilar suspension, it is found that after a certain difference of potential the sensitiveness decreases rapidly, and that the deflection attains a value beyond which it cannot go. This is shown to be due to the impossibility of practically realizing a perfect symmetry of the system formed by the quadrants and the needle, and to the existence of a disturbing electric couple which is proportional to the square of the difference of potential between the quadrants. By a careful construction the limit can be increased almost indefinitely. With his instrument, in use at the Eiffel Tower observatory, he can measure voltages as high as 2000, or even higher.—*Jour. de Physique,* October; abstracted in Lond. *Elec.,* Nov. 23.

Electric Traction and Magnetic Records.—Evershed.—A communication referring to the differences between the Kew observatory authorities and the tramway companies. He says that the determination and maintenance of the fundamental standards of measurements, and the comparison and certification of sub-standards come clearly within the scope of a State-aided observatory, and nothing ought to be allowed to imperil the continuity and accuracy of such work. He denies, however, that the same is the case with records of terrestrial magnetism; he says that the future continuity of magnetometer records is hardly a matter of vital consequence.—Lond. *Elec.,* Nov. 23.

REFERENCE.

Measuring Instruments for Alternating Currents.—Benischke.—A long, illustrated French abstract of the German paper on some new instruments of the Gen. Elec. Co., of Berlin, which was abstracted in the Digest June 16.—*L'Eclairage Elec.,* Oct. 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy Transmitter.—von Czudnochowski.—An illustrated description of the following arrangement for obtaining waves of greater length than with the Righi radiator. The two globes, forming a spark-gap, are connected to the secondaries of an induction coil; they are also connected by two wires of equal length to the outside metallic coatings of two Leyden jars; the inner coating of one jar is connected to the vertical wire, while that of the other wire is grounded, which however does not seem necessary.—*Phys. Zeit.,* Nov. 17.

REFERENCES.

Toll Lines.—Riggs.—An illustrated description of the long distance service of the Erie telephone system.—*Elec. Rev.,* Nov. 28.

Electric Clock.—An illustrated description of an electromagnetic device of Fery for regulating the oscillations of a pendulum.—*Cosmos,* Nov. 17.

Electric Clock.—Hopkins.—An illustrated description in detail of an electric clock devised by him, which he calls an "electric earth clock" as the power is furnished by a battery of plates of copper and zinc, buried in the earth.—*Sc. Amer. Sup.,* Dec. 1; more briefly in *Sc. Amer.,* Dec. 1.

MISCELLANEOUS.

Electrical Smoke Deposition.—Wright.—An article on the practical possibilities of electrical smoke deposition, which would be of importance in the neighborhood of large smoke-producing establishments. Reference is made to an old paper of Lodge, founded on Tyndall's well-known experiment, which consists in holding a heated body in the path of a ray of light, when a dark, dust-free space is produced in its neighborhood. Lodge also made the following experiment with a suspended body, which was electrified in an atmosphere artificially charged with smoke; on raising the potential to some thousands of volts by means of an influence machine, to such a point that a brush discharge was possible, the "dark space" (that is, the dust-free space) was suddenly and rapidly widened, and the smoke being diffused, was deposited on the sides and bottom of the containing vessel. The best effects were produced when the conductor took the form of a point, the smoke depositing like a map along the direction of the lines of force. The explanation is that the smoke particles become electrified by induction and are attracted to one another, and also to the opposite pole, in a similar manner to iron filings in the vicinity of a magnet. A similar effect is obtained with vapor or damp smoke, which is condensed in the form of mist or fine rain. There are two difficulties in the practical application of this process; one is the natural draught in an active chimney or flue. If a system of pointed conductors is fitted to the top of the chimney, and surmounted at a short distance above by a cap or dome of electrified wire gauze or netting, it has been found to assist the draught, and also to condense some, though not all, of the smoke. Another plan suggested by Lodge is to suspend a sheet, or sheets, of wire netting, provided with numerous points, or barbs, longitudinally along a flue, or chimney, and to oppose an opposite conductor on the walls of the chamber in the shape of a series of points. Another difficulty lies in the insulation between the two poles, owing to the deposition on the conductors of soot and smoke particles. To obviate this, he suggests a protective insulating sleeve extending over, though not actually touching, that portion of the conductor nearest its point of support for a few inches from the latter. This would at least protect the actual fixture from deposit, and, as to the extremities of the conductors, the natural draught would probably assist in keeping them clear of excessive deposition, at least for a certain period.—Lond. *Elec. Rev.,* Nov. 23.

REFERENCES.

Electrical Engineering a Profession or Trade.—A discussion of the address of President Perry, abstracted in the Digest last week. Most of the discussion is favorable and in the nature of praise, the critics in general agreeing with him that electrical engineers have too little scientific and mathematical training, and should have more. The paper and discussion refer chiefly to the conditions in England, but apply also largely to the United States.—Begun in *Lightning,* Nov. 15, 22.

Electric Heating.—Boelling.—An illustrated article on different forms of electric heating apparatus. The apparatus of Stutz, Helberger, Le Roy, Dowsing, the Prometheus Company and the General Electric Company of Berlin, are briefly described and illustrated.—*Elek. Anz.,* Nov. 1.

Paris Exposition.—Gavey.—An illustrated paper, read before the British Inst. of Elec. Eng., on telegraphs and telephones at the exhibition. He describes the multiplex telegraph systems of Delany, Rowland, Mercadier, the Pollak and Virag printing telegraph. He further discusses central battery telephone switches, Postel-Vinay switches, the Siemens & Halske switchboards, party-line telephones and the use of carbons for microphones. He briefly refers to the wireless telegraphy systems exhibited, and describes the Poulsen telegraphone.—Lond. *Elec.,* Nov. 23; abstracted in Lond. *Elec. Eng.,* Nov. 23.

Brown.—An illustrated article on electricity at the Paris Exhibition, written "from a British point of view."—*Cassier's Mag.,* December.

An illustrated description of telephone and telegraph apparatus exhibited by Czeiza, Nissel & Co.—*Der Elec. Tech.,* Nov. 15.

Perkins.—A brief illustrated description of turbine exhibits of Escher, Wyss & Co., of Zurich.—*West. Elec.,* Dec. 1.

An illustrated description of an engine of Dujardin & Co., driving a 1120-kw three-phase generator of Schneider & Co., the number of revolutions being 72; also of a steam driven 800-kw three-phase generator of the Companie de Five-Lille, the number of revolutions being 79.—*Zeit. fuer Beleucht.,* Nov. 20.

Montpellier.—An illustrated article on the direct current dynamos exhibited by the Companie Generale d'Electricité de Creil.—*L'Elec.,* Sept. 29.

Reyval.—Illustrated descriptions of the Pollak accumulator, and of electric heating apparatus of Parville Bros. for tramways.—*L'Eclairage Elec.,* Sept. 22. An illustrated description of the 3000-kw alternator of the General Elec. Co. of Berlin.—*L'Eclairage Elec.,* Sept. 29.

Well-illustrated descriptions of a 1200-kilovolt-ampere alternator, a 50-kw direct current generator and a 200-kw direct current generator of the Société de l'Eclairage Elec.—*L'Eclairage Elec.,* Oct. 6.

Girault.—The first part of a long and well-illustrated description of machines exhibited by Schneider & Company. This part deals with direct current machines of the Thury type; a 396-kw dynamo, running at 2500 r. p. m., a 14.3-kw dynamo running at 950 revolutions, a 41.5-kw dynamo running at 650 revolutions, and a tramway motor are described.—*L'Ind. Elec.,* Oct. 25.

An illustrated translation in full of the French article on the Ougrimoff "electric calorimeter," noticed in the Digest Oct. 20.—*El'ty,* Dec. 5.

Dory.—An illustrated description of a sea compass, exhibited by Heit. It shows to the steersmate the course ordered by the captain; it registers this course as well as all deviations; by a bell it advises the captain of the deviations.—*L'Elec.,* Oct. 13.

BRUNSWICK and ALIAMET.—A very long and well illustrated description of the Boucherot compound alternator (Digest, Oct. 27).—*L'Elec.*, Oct. 20.

ALIAMET.—A well illustrated description of the Leblanc compound alternator (ELEC. WORLD AND ENG., Aug. 18, p. 242).—*L'Elec.*, Oct. 27.

REYVAL.—Illustrated descriptions of a 2000 kilovolt ampere three-phase generator of Siemens & Halske, the voltage being 2000, the speed 90 r. p. m.; of speed regulators for turbines, exhibited by Escher, Wyss & Co., and by Rusch; of a Riedler high pressure pump, operated by a 75-hp three-phase induction motor of the General Electric Co., of Berlin; of an Ehrhardt & Schmer pump, operated by a 75-hp three-phase induction motor of Lahmeyer & Co.—*L'Eclairage Elec.* Oct. 13.

REYVAL.—Illustrated descriptions of a steam-driven 1400 kilovolt-ampere three-phase generator of Dujardin & Schneider, the voltage being 3000, the speed 71.5 r. p. m.; of a 200-kw three-phase generator of the United Electric Co., of Vienna, the voltage being 220, the speed 110.4 r. p. m.; of the Tribelhorn storage battery, the plates of which form the retaining cell.—*L'Eclairage Elec.*, Oct. 20.

REYVAL.—Illustrated descriptions of a steam-driven 825 kilovolt-ampere three-phase alternator of Kolben, the voltage being 3000, the speed 94 r. p. m.; of the Fulmen storage battery; the Blot battery, and the Blot-Fulmen battery.—*L'Eclairage Elec.*, Oct. 27.

BORCHERS.—Continuations and conclusion of his long illustrated serial (Digest, Oct. 20) on electro-chemical exhibits. He describes the Janty zinc-copper cells, of which he thinks well for small installations and for use in the house and laboratory; in Paris the manufacturers keep all cells installed in order in exchange for the copper deposited and for payment of the required copper sulphate. He further discusses the production of fluorine, ozone, phosphorus, the utilization of inferior carbide, especially waste carbide, for the production of amorphous carbon and hydrogen; the production of graphite; pure (white) calcium, aluminum, gold, silver, copper, etc. He gives brief references to galvanic plating and deals at greater length with the production of carbides and silicides, and with the alkalies and chlorine industry. The article is concluded by a description of different apparatus and instruments, especially those exhibited by the electro-chemical institute of the University of Goettingen. A summary of the work done in this institute since it was founded in 1895. is given.—*Zeit. fuer Elektrochemie*, Oct. 4, 18, Nov. 1.

New Books.

DYNAMO-ELECTRIC MACHINERY. Its Construction, Design and Operation. Direct Current Machines. By Samuel Sheldon, A.M., Ph.D., assisted by Hobart Mason, B.S. New York: D. Van Nostrand Company. 280 pages, illustrated. Price, $2.50.

This work is intended for students of electrical engineering. It is divided into fourteen chapters. A knowledge of elementary algebra is assumed. The style is clear and the matter well illustrated. The description is particularly adapted to the work of the practical engineer, the theory being developed no further than is necessary for this purpose. The work is well up to date, except that the term "lines of force" is used in spite of "Maxwells," possibly because the manuscripts may have been set up before the action of the recent Paris Electrical Congress. The chapters devoted to the study of controlling and operating motors are particularly good. The final chapter is devoted to the electrical testing of dynamo machinery. Owing to the limitations in size of the book, the treatment is necessarily condensed, but it is thorough and reliable. The book will be greatly appreciated by the class of readers to which it is addressed.

MANUAL OF INSTRUCTIONS, FORMS AND SCHEDULES.—For use in the Electrical Engineering Laboratory of the University of Illinois. Prepared by Prof. Wm. S. Aldrich, M.E., and Prof. W. H. Browne, Jr., A.B., Champaign, Ill., University of Illinois.

This volume is somewhat unique in book-making, the text matter being reproduced by the typewriter manifold process and the illustrations consisting of blueprints, there being about 100 pages of the former and 56 sheets of illustrations. The object of the manual is to furnish an outline and a guide for students taking courses in the electrical engineering laboratory of the University of Illinois. Following a number of forms relating to details of instruction, directions for laboratory work are given under the heads of general and direct-current work, alternating-current work and photometry. In alternating-current work, for example, the following subjects are treated: Measurement of inductances, inductance of alternating armatures, determination of angle of lag, power and power factor of alternating currents, measurement of capacity, inductances and capacities in series and in parallel, transformer operation and testing, coupling alternators, synchronous and induction motor and rotary converter working, alternating-current transmission. Directions for performing the various experiments and for making measurements are given in concise form with references to accompanying illustrations. A valuable feature of the book consists of a reference list of books and of articles in periodicals of assistance to the student in connection with the subjects treated.

LE MAGNETISME DU FER. Par Ch. Maurin. Paris: Georges Carre and C. Naud. 100 pages, 20 illustrations. Price, 2 francs.

This little book is a brief treatment in the French language of the principal facts and theories of magnetism. It is divided into six chapters, named, respectively: General Phenomena—Particular Consideration of Soft Iron, Steel and Cast Iron; Magnetization and Time; The Energy Dissipated in Magnetization; The Influence of Temperature, and The Theory of Magnetism. The last-named is a brief discussion of Ewing's and Ampere's theories. It is, of course, only possible to give the merest outline of the various subjects treated within the compass of 100 small pages, but the matter is clear and well up to date.

BOOK RECEIVED.

THE COST-KEEPER. Some Original Systems of Shop Cost-Keeping or Factory Accounting. By Horace Lucien Arnold. New York: The Engineering Magazine Press. 408 pages. Price, $5.00.

Directory of Electrical Societies, Etc.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., 1901.

LEAGUE OF AMERICAN MUNICIPALITIES. Next meeting, Charleston, S. C., Dec. 12-15.

ROENTGEN SOCIETY OF THE UNITED STATES. Next meeting, New York, Dec. 13.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, October, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, June, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, New York, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

Removal of the Erie Telephone Offices to New York.

As already noted, the Erie Telephone & Telegraph Company has been breaking up its headquarters at Lowell in order to remove to Boston and New York. The Lowell office was closed on Saturday, Dec. 8, and the New York office will be opened during the week ending Dec. 15. The force in the New York office will consist of: Chas. J. Glidden, president; H. J. Pettengill, vice-president; Geo. B. Perham, secretary and auditor; T. W. Greenslitt, manager advertising department. The personnel of the New York office will be as follows: Anthony Bucek, private secretary to the president; bookkeepers, Lavern H. Harrington, Wm. T. Trull, Wm. D. Keniston, Frank J. Libby, Wendell Blanchard, Wm. E. Dexter; clerks, Burton W. Buck, Anthony L. Holt; stenographers, J. P. Crowley, J. C. Wilbur, James A. Nixon.

The force in the Boston office will consist of Charles E. Adams, vice-president, and Charles A. Grant, treasurer. The office force will be: Arthur L. Brown, confidential secretary; J. Clark Glidden, confidential clerk and telegrapher; Herbert C. Hodgman, Wm. Morris, clerks; Fred W. Mills, transfer and dividend clerk. The Boston and New York offices will be in communication with each other constantly.

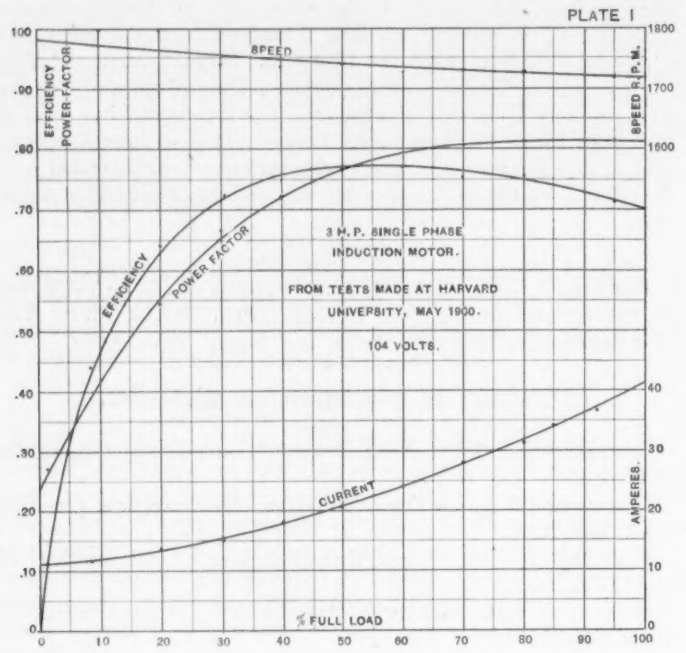
The Erie is the outgrowth of the first telephone exchange in Lowell and one of the first in the world, established by Mr. Glidden 23 years ago. The Erie offices were established in Lowell 17 years ago. The business was opened by Mr. Glidden with a capital of $6,000 out of which has grown the great Erie and New England systems, employing fully fifty millions of capital and 18,000 people, and operating 200,000 telephone stations.

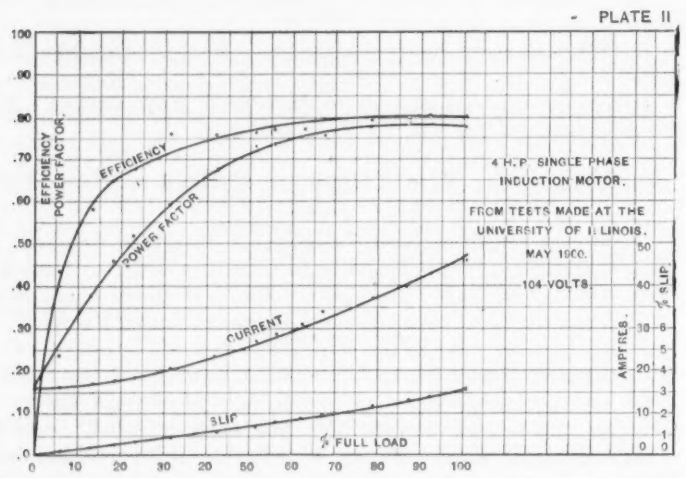
The offices in New York are at 100 Broadway, on the 18th floor, and were occupied by the Telegraph, Telephone & Cable Company of

America, which has moved its engineering force up to the big building of the Knickerbocker Telephone & Telegraph Company in Broome Street, where it occupies a suite of rooms.

Tests Made Upon Single-Phase Alternating Current Motors.

During the spring term of the past college year some comprehensive and interesting tests were made by the electrical departments of several of the leading universities on self-starting single-phase motors, and through the courtesy of the Wagner Electric Manufacturing Company curves embodying some of these results appear herewith. Since the single-phase self-starting type of alternating current motor is of relatively recent appearance, especial interest is attached to these results.





FIGS. 1 AND 2.—CURVES OF TEST OF SINGLE-PHASE ALTERNATING CURRENT MOTORS.

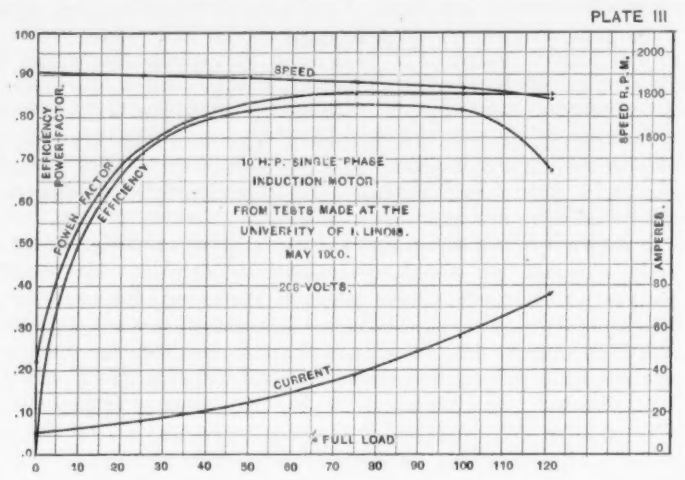
In Plate I. are presented results of tests made under the direction of Prof. S. E. Whiting, of Harvard University, upon a 3-hp 104-volt self-starting Wagner motor. In Plates II and III appear corresponding test results on a 4-hp and a 10-hp 60-cycle machine of the Wagner make, which were made under the direction of Prof. W. S. Aldrich, of the University of Illinois. In Plate IV appear the same general results made upon a 15-hp 60-cycle motor, also of the Wagner Company's design, under the direction of Prof. W. E. Goldsborough, of Purdue University.

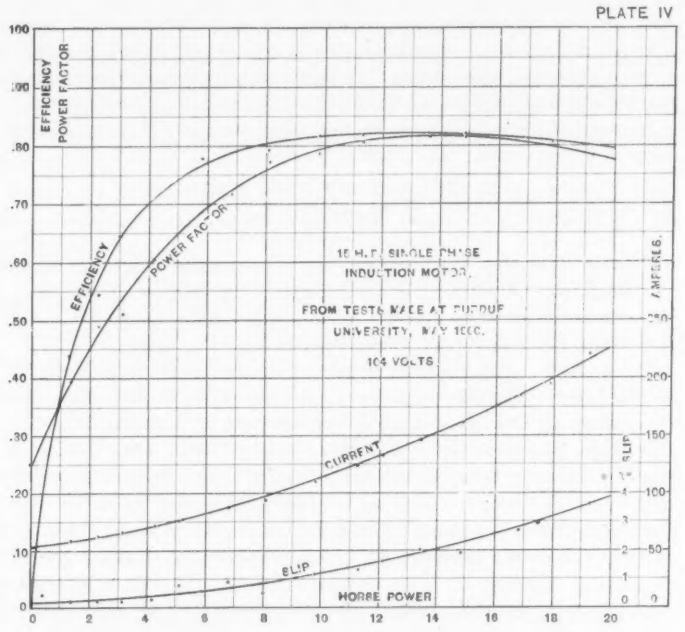
In all of these plates are given power factor, efficiency, current and speed test results, and it will be noted that the performance of the motors is uniformly excellent. In plates 1 and 2 the curve is carried to full load only, while in plates 3 and 4 the test was carried to about 25 per cent above the rated capacity of the motors.

While these curves show a maximum output of about 25 per cent in excess of the rated output of the motors tested, it should be noted that the makers provide them with a loop terminal, by the use of which a part of the field or primary turns can be cut out of circuit, thus increasing the output about 25 per cent at normal voltage, enabling the motors to take care of temporary loads up to 150 per cent of their rated capacity, when operated on this loop. In some tests on the power factor and efficiency of a 5-hp 60-cycle motor, tested at different voltages, the output was almost directly proportional to the square of the impressed voltage within the limits of the tests, and even at the larger outputs, the power factor and efficiency dropped off only a little.

The above and similar test results which have been reported are serving to remove much of the skepticism many conservative central station men have entertained relative to the commercial practicability of single-phase alternating current motors, and a very general use of motors of this type seems likely to develop rapidly in those fields where a single-phase motor is either necessary or desirable by reason of its simplicity of installation. The Wagner Company's type of motor does not depend upon the rotary field principle for its starting torque, and therefore occupies a field entirely independent. The Wagner Company contends that its motor is unique in that it employs but a single field winding, which suffices through the medium of the starting construction employed to start under full load, or even greater if desired; and yet it embodies all the advantages of the most approved forms of multiphase alternating current motors in simplicity of construction and durability.

Results equal to the best multiphase motors, and up to the average of the best direct current motors are assured for these machines, and the same guarantee as to durability is made by the manufacturers as is customary for the best direct current motors.





FIGS. 3 AND 4.—CURVES OF TEST OF SINGLE-PHASE ALTERNATING CURRENT MOTORS.

G. I. Alternating Series Enclosed Arc Lamp.

The lamp illustrated herewith is designed to operate on constant current alternating circuits, the only limitation to the number that may be connected in series being that each lamp must have not less than 80 volts at the terminals. The lamp is operated on the shunt principle and is provided with an automatic cut-out and a hand switch, the working parts of which are placed under the top casting for protection. A feed lever is provided which carries on one end a lead weight; to the other a U-shaped laminated core is attached. Two shunt coils connected across the arc surround the legs of the U core. The clutch operates directly on the carbon. There are no windings in series with the arc. The arc voltage is the same as at the hangers and the only loss in the lamp is from the power consumed by the shunt regulating coil, which absorbs about 10 to 12 apparent or 5 to 6 actual watts. The efficiency of the lamp is stated to be about 97.4 per cent and the power factor 85 to 90 per cent. The life of one pair of carbons (one cored and one solid) varies between 75 and 90 hours, the lamp being usually adjusted for 72 volts at the arc. On account of the absence of series coils the lamp, while in operation, keeps very cool. All parts of the lamp are so designed that they may be readily inspected or repaired. These lamps may be used for either street or commercial lighting.

The regulator, which is also illustrated, is designed to maintain a constant current on alternating current circuits of arc lamps or arc and incandescent lamps connected in series. The source of supply may be either primary or secondary. If the former, the lamp circuit is connected, through suitable safety devices, to the primary bus-bars which are supplied direct from the generator, in which case the potential of the generator must allow not more than 90 nor less than 80 volts per lamp including the regulator.

If the desired number of lamps to be operated in series of each circuit is greater than 25 or 26, it is necessary to use a secondary source of supply. This is obtained from the secondary winding of a constant potential step-up transformer which is connected between the primary supply and the arc circuit. The application of a step-up transformer permits of transforming the low primary pressure to the necessary pressure for a large number of lamps in series. A further advantage of using a transformer between the generator and each lamp circuit is that it prevents any disturbance in the primary part of the system if one of the arc circuits should become grounded. The actual loss in the regulator is constant at all loads from short-circuit to full load, the aggregate being about 140 watts actual loss on a 25 to 27-light regulator adjusted for 6.8 amperes on 2200 volts, 60 cycles.

The regulator consists of two reactance coils connected in series with the lamps. A laminated U-core is suspended under these coils in such a way that it can move up and down in the field of the coils. Should a short-circuit occur on the outside line and current be turned on, the U-shaped core is immediately drawn up into the coils, which then react against the line potential and keep the current constant at the value for which the regulator is adjusted to operate. When the short-circuit is removed the current of the circuit will fall, allowing the core to drop down. This decreases the reactance of the regulator and enough of the line potential is allowed on the lamp circuit to start and operate the lamps. If one or more of the lamps should be switched off, or cut out, the resistance of the lamp circuit decreases while the current increases. The regulator coil then attracts the core which, when entering the coils, further increases the reactance and the current is again brought to its given value. A dash-pot is attached to the core to prevent sudden fluctuations and to aid the starting of the lamps.

The standard size regulator is made for 25 lamps operating on 2000 to 2200 volts, 60-cycle circuits. The usual current for which the regulator is adjusted is 6.5 to 7 amperes, 6.8 amperes being considered standard for 72-volt lamps. The total height of a 25-lamp regulator is 34 ins. and the weight is about 100 lbs., the floor space required being 14 ins. by 19 ins.

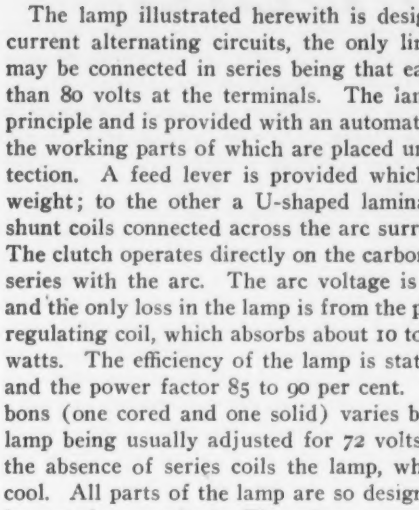


FIG. 1.—LAMP WITH REFLECTOR.

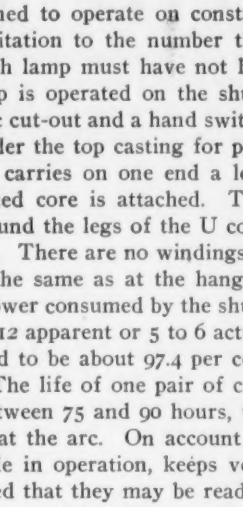


FIG. 2.—REACTANCE COILS.

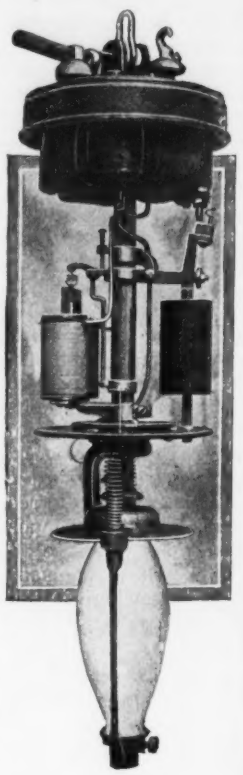


FIG. 3.—MECHANISM OF LAMP.

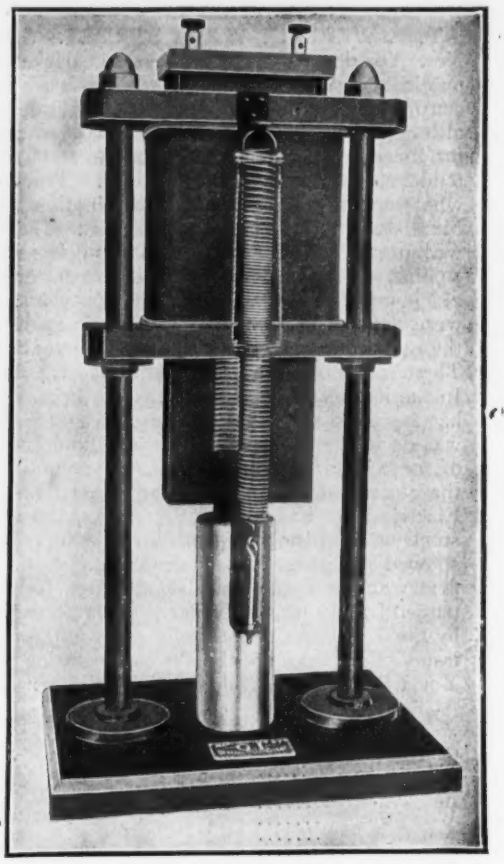
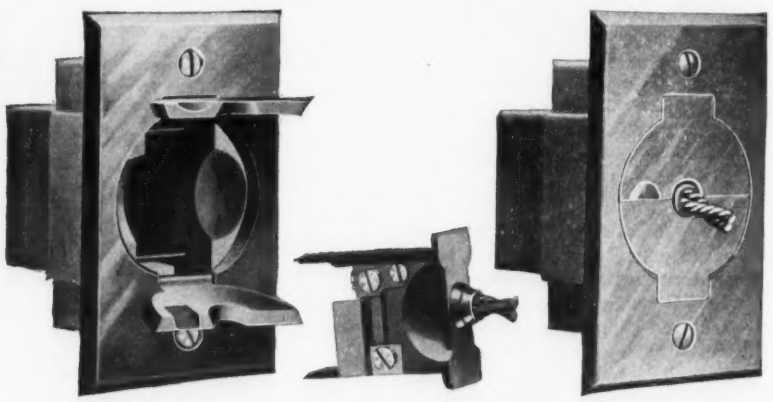


FIG. 4.—REGULATOR.

New Flush Plug Receptacle.

Messrs. Zimdars & Hunt, New York, have placed upon the market an improved form of their plug and receptacle embodying some new and desirable features. As now made, binding posts are provided at the top of the receptacle, and as the face plate is removable, the wire connections can be quickly and easily effected when the receptacle is in place. The plug, which in this new model has fuse connections, is provided with knife blades fitting into substantial clips in the base of the receptacle, thus giving a contact of considerable area. The peculiar arrangement of the receptacle doors and plug, which allows of the doors being closed over the plug when in place, is retained in this new model.



FIGS. 1, 2 AND 3.—FLUSH PLUG RECEPTACLE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculative activity on the New York stock market last week slackened very perceptibly, the public being no longer vigorous buyers. The professional element continued to exhibit more or less disposition to work on the bear side, although, as far as railroad shares were concerned, the impression produced was rather small. In the industrials, however, declining tendencies were more pronounced. Traction stocks were, on the whole, quiet, the rumors of a combination between Metropolitan and Manhattan not obtaining any support. These stocks closed the week with net losses, that of Metropolitan being 6 points and of Manhattan 1 point. Brooklyn Rapid Transit also declined, the closing price being 2¼ points below that of the week previous. The sales of this stock were 102,260 shares. General Electric made a net gain of 1¼ points, the quotation throughout the week fluctuating between 166½@169⅞. The number of shares sold was 4200. Western Union lost 1⅛ points. In the market for outside securities there was more irregularity than has appeared at any time during the past month. In some cases there was decided strength in prices, and final quotations marked net gains of some importance, but elsewhere in the list net losses appeared. In the electric stocks more life appeared than during any recent week. Electric Boat was particularly strong, and though transactions in the stock were on no large scale, the common as well as the preferred showed net gains of 5 points or more. Electric Vehicle was much firmer and in better demand, although the transactions were not attended by any large advance. The absorption of the Riker Company by the Electric Vehicle Company is noted in detail elsewhere in this issue. Following are the closing quotations of electric stocks in New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Dec. 1.	Dec. 8.		Dec. 1.	Dec. 8.
Gen. Electric	168½	169¾	Elec. Veh.	18¼	19
Bklyn Rap. Tran.	72⅜	70⅜	Elec. Veh., pfd.	36	36
Met. St. Ry.	171	165	Gen. Car.	5¾	4¾
Am. Tel. & C.	—	—	Ill. Elec. Veh. Tran.	1¼	1
West. Un. Tel.	83⅛	82	N. Y. Elec. Veh. Tran.	6½	6½
Am. Dist. Tel.	36	35¼	N. E. Elec. Veh. Tran.	3¾	3½
Com. Cable.	—	—	Tel. & Tel. Co. of Am.	3	3
Elec. Boat	18½	22¾	Hud. Riv. Tel.	116	116
Elec. Boat, pfd.	35	38	N. Y. & N. J. Tel.	150	150

BOSTON.

	Dec. 1.	Dec. 8.		Dec. 1.	Dec. 8.
New Eng. Tel.	—	—	Erie Tel.	109½	104¾
Mex. Tel.	2⅝	2¼	Gen. Elec., pfd.	—	143
Westing. Elec.	—	51½	Am. Tel. & Tel.	159	154
Westing. Elec., pfd.	64½	—	Ed. Elec. Lt.	—	—

PHILADELPHIA.

	Dec. 1.	Dec. 8.		Dec. 1.	Dec. 8.
Elec. Stor. Bat.	89	88	Phil. Elec.	4⅝	4½
Elec. Stor. Bat., pfd.	95	94	Pa. Elec. Veh.	3	4
Elec. Co. of Am.	9⅞	8⅝	Pa. Elec. Veh., pfd.	*2	1½
Gen. Elec. Auto	¼	¼	Am. Rys.	35¾	35¼

CHICAGO.

	Dec. 1.	Dec. 8.		Dec. 1.	Dec. 8.
Chicago Edison	142	142	Chicago Telep. Co.	221	235
Chic. City Ry.	255	255	Union Traction.	12¾	12½
Nat'l Carbon	16½	16½	Union Traction, pfd.	53	54½
Nat'l Carbon, pfd.	84	84½	Northwest Elev. Com.	28	28

*Asked.

MASSACHUSETTS ELECTRIC.—The first annual report of the Massachusetts Electric Companies, which owns 14 operative lighting and street railway properties, these being in turn a consolidation of many more, shows a gross of $5,518,837 and a net of $1,859,500, the net being $208,297 more than in 1899. There has been expended on improvements and extensions during the year $1,055,245. By far the larger part of this expenditure represents additions to the properties and was therefore charged to capital account, but $154,872 was charged to reconstruction suspense account. The amount of dividends received by the Massachusetts Electric Companies from the earnings of the year 1900 is $598,273. The difference between that amount and the total amount of dividends received by the Massachusetts Electric Companies, namely, $209,038, comes from the dividends, declared from the earnings of 1899 by the companies in which you were interested at the time of the declaration of those dividends, a considerable number, although not all of the shares now owned by you having been taken over in June, 1899. Inasmuch as the shares were taken over at various dates, differing proportions of the total dividends declared for 1899 were received by your trustees. A comparison of the amount of net divisible income of all the operating companies with the dividends declared by those same companies shows that only about 74 per cent of the amount applicable to dividends has been paid to stockholders. It has been felt that in view of the large amount of work now being done on the properties and the advisability of providing reconstruction reserves, conservative management demanded that the other 26 per cent of the net divisible income should remain for the benefit of the properties.

PHILADELPHIA UNION TRACTION.—President Parsons, of the Union Traction Company, says: "In view of persistent rumors that a call is about to be made on the stockholders of the Union Traction Company, it has been thought wise by members of the board that I should make a definite statement regarding the financial condition of the company. It has in its treasury unpledged, $8,000,000 and upwards of first-class marketable securities, and by Dec. 15, 1900, it will have no floating debt. For the purpose of increasing its business and accommodating the public in view of the rapid growth of the city in all directions, it has necessarily been compelled to make, and has made many important extensions to its lines and equipment, and contemplates making still further extensions which should be completed by Jan. 1, 1902, which will cost from $1,000,000 to $1,250,000. These extensions and such others as the future growth of the city may require add largely to the value of the property of the stockholders and the earning capacity of the company, without any increase in its fixed charges. It has not been deemed necessary thus far to make any further call upon its stockholders, but when that work is completed, and not before, it is the intention of the directors to ask the stockholders to contribute additional capital to pay for it and to restore to the surplus account the earnings which have been expended for capital account."

ALLEGED TELEPHONE DEAL.—It is alleged that plans for the combination of independent telephone companies are rapidly nearing completion and details will be announced shortly. An agreement has been practically reached. Alexander Brown, of Baltimore, is a leader in the movement. The proposition is to combine the Maryland Telephone & Telegraph Company, of Baltimore; the Pittsburg & Allegheny Telephone & Telegraph Company, of Pittsburg; the Home Telephone Company, of Pennsylvania; the Allegheny County Telephone Company, of Pennsylvania; the Delmarvia Telephone Company, of Wilmington, Del.; the Erie Telegraph & Telephone Company, of Boston, which controls the Cleveland Telephone Company; the Northwestern Telephone Exchange Company, the Southwestern Telegraph & Telephone Company, the Michigan Telephone Company and the Wisconsin Telephone Company. The Telephone, Telegraph & Cable Company of America, one of the largest of its kind in the United States, will be included. The capitalization will be about $50,000,000. The new company will have a total of 170,000 subscribers. President Charles J. Glidden, of the Erie (Bell) Telephone system, says there is no truth in the above statement sent out from Baltimore that the Erie Telephone Company is to consolidate with the independent telephone companies of Maryland and Pennsylvania.

WESTCHESTER PROPERTIES.—The United Gas Improvement Company has acquired the lighting properties in Westchester County, N. Y., just consolidated under the name of the Westchester Lighting Company, with $10,000,000 common stock and $2,500,000 5 per cent preferred stock, as noted recently. The companies constituting the Westchester Company are: Port Chester Electric Lighting Company, Larchmont Electric Light Company, the Pelham Electric Light & Power Company, East Chester Electric Company, Mount Kisco Lighting Company, Huguenot Electric Light, Heat & Power Company, New York Suburban Gas Company, the Westchester Gas Light Company, the Yonkers Gas Light Company, Municipal Gas Company, of Yonkers, Westchester Gas & Coke Company. It is understood about $3,000,000 bonds will be issued at once.

DIVIDENDS.—The Columbus (Ohio) Edison Company has declared a dividend of 3 per cent on the preferred stock, payable Jan. 2. The Union Passenger Railway, Philadelphia, has declared a dividend of $4.75, payable Jan. 1. The West Philadelphia Passenger Railway has declared a dividend of $5 per share, payable Jan. 1. The Cincinnati Street Railway Company has declared the regular quarterly dividend of 1¼ per cent, payable Jan. 2. The Chicago Telephone Company has declared a dividend of 3 per cent, payable Jan. 2. The Alley Elevated Railway has declared a quarterly dividend of three-quarters of one per cent, payable Jan. 1. The Street Railway & Illuminating Properties has paid $2 a share on the common stock to stock of record Dec. 3. The Commercial Cable Company has declared a quarterly dividend of 1¾ per cent, with a bonus on 1 per cent, payable Jan. 2, 1901.

WISCONSIN TELEPHONE COMPANY.—As briefly announced in our issue of Dec. 1, the Wisconsin Telephone Company, at its recent annual meeting increased its capital stock form $3,000,000 to $5,000,000. It is probable that not less than $1,000,000 will be expended during the coming year for the improvement of present facilities and the extension of telephonic service. The extension of the Milwaukee underground system to accommodate 15,000 patrons will require a good share of the sum appropriated; while the total sum to be ex-

pended in Milwaukee will in all probability equal that required for the State at large. The $2,000,000 of new stock will be offered to the old stockholders at par.

GENERAL ELECTRIC DIVIDEND.—The directors of the General Electric Company have declared the regular quarterly dividend on the common stock of 2 per cent, payable Jan. 15. The directors also declared an extra dividend of 1 per cent, payable same date, for the purpose of making the dividends for the year 1900 8 per cent. Two previous dividends of 1½ per cent have been paid during this year and one of 2 per cent.

CANADIAN BELL.—At a meeting of the shareholders of the Bell Telephone Company in Montreal the directors were authorized to issue $2,500,000 of debenture bonds, and more common stock if deemed necessary.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies show that the general trade conditions continue favorable, and on the whole the outlook is satisfactory and encouraging. Activity continues in the iron and steel industries. The rush, however, seems to be over, and business is now regarded as having attained normal conditions. In summing up the situation, Bradstreet's reports that there are a quieter tone and a reduced volume of wholesale business in many lines. This, however, is looked for at this season of the year. In the iron and steel markets finished products monopolize the activity. The rail market is active, 60,000 tons having been sold in Chicago during the week. The total amount of orders booked in the rail mills is said to be 1,000,000 tons. According to Bradstreet's summary, the week's failures aggregated 224, as against 184 the previous week, 220 the same week last year, 237 the same week in 1898; 292 in 1897, and 381 in 1896. In the copper market, Lake is firmly held at 17c., electrolytic and casting remaining unchanged at 16⅝c.

ROCK ISLAND ARSENAL.—According to the report of the Chief of Ordnance of the War Department, provision has been made at the Rock Island arsenal for the establishment of a new small arms factory. Appropriations aggregating $859,000 are now available, the plans and details of the entire installation have been completed and proposals are soon to be invited for the necessary machinery and materials, everything being in readiness for the machinery as fast as the contractors may deliver it. A new power house has been begun and the power will be developed in 14 Samson-Leffel 50-in. turbines, each of 100 to 130 horse-power, according to the head of water, divided into two groups of seven each, but so arranged that they can be coupled or run separately. A 500-kw generator, alternating, of 600 volts will be coupled direct to each of the main shafts. Sixty-one motors, ranging from 3 to 53 horse-power, will be employed. In commenting on these changes, the report says: "The prospect afforded by electric transmission presents a pleasing contrast to the former state of affairs in respect to the power resources of this arsenal. Prior to the Spanish war eight turbines of nominally 35 horse-power, transmitting power by wire ropes, could furnish only 200 to 250 effective horse-power, and during the war it became necessary to supplement this supply with steam engines. The electric system will give 1400 to 1800 horse-power, and even this can be easily increased to the full limit of the available water flow in the pool above the dam."

VANDERBILT POWER PLANT.—It is stated that the Vanderbilt interests, through the agency of the Niagara, Lockport & Ontario Power Company, will build a great power plant, rivaling in extent the famous Niagara Falls plant, will construct a big aqueduct from Lake Ontario to Lockport to supply that city with water, cut a wide power canal from Niagara River, build a power transmission line to Depew, and make of Lockport and Depew electric cities. The Lockport & Newfane Company is backed by the International Traction Company, and is making a fight for the water contract. The first mentioned company holds the franchise for a power canal, and, contending that it has enlisted the support of the New York millionaires, has given the city to understand if it makes a water contract with it the company will build the big canal. It stands ready to buy the right of way, which will cost $1,000,000, while the aqueduct from Lake Ontario will cost another million, and construct the power canal from Niagara River, which will cost $8,000,000. The electric power generated will be supplied to the Central shops and other factories at Depew. The city will probably accept the Vanderbilt offer.

DETROIT MUNICIPAL ELECTRIC LIGHTING PLANT.—The contract for the lighting plant extensions of the city of Detroit, Mich., has been let to the Northern Electrical Manufacturing Company, of Madison, Wis., for $35,865. The apparatus called for is to be of Northern and Stanley make. The bids of but three companies were considered, namely, the Westinghouse, the Northern and the General Electric. The extraordinary closeness of the bids of these three concerns is remarkable, the Westinghouse being only $166 and the General Electric but $9.05 higher than the Northern Company. The difference was so slight that it was considered entirely negligible by the commissioners. It may be worth while saying, in view of the small differences in price on the above bids, that it is a favorable indication of careful estimating, showing that the larger electrical companies have arrived at a very exact basis of manufacturing and construction cost.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis Mo., has opened a branch office at 1227 Real Estate and Trust Building, Broad and Chestnut Streets, Philadelphia, and has engaged the services of Col. D. H. Garrett as manager. Colonel Garrett has been identified with the incandescent lamp business for some years past and is well known in Philadelphia and the surrounding territory. It is the intention of the company to carry a considerable stock of lamps in Philadelphia, thus placing it in a position to give prompt attention to the demands of its customers. The company now has offices in New York, San Francisco, Minneapolis, Boston and Chicago, besides the one in Philadelphia and the headquarters in St. Louis; so that it is able to promptly meet its customers' requirements in practically every part of the country.

AMERICAN TOOLS IN ENGLAND.—A representative of the British Westinghouse Company is in this country securing estimates upon the machine tools required for its new works; specifications are being given out and bids asked for. The sum of money to be expended amounts to some hundreds of thousands of dollars. A company in the North of England, which does not wish its name made public, has bought the U. S. Machinery Building, which was situated at Vincennes during the Paris Exposition. It will take down the building and re-erect it in England, taking with it the dynamo, traveling crane, engine, boilers and all the other plant. American machinery will be purchased for the work which is to be done in it after its re-erection, and the orders are to be placed in the near future. Charles Neat & Co., of London, engineered the sale.

CINCINNATI TOOL COMPANY will move to its new works about Jan. 1. The new property covers about 25,000 sq. ft., and is situated on Waverly Avenue and the C., L. & N. Railroad at Norwood, Ohio. The building is a one-story brick building with light on four sides, and is specially arranged for the manufacture of their goods. An electric lighting plant has been installed. A number of improvements have been introduced looking to larger and quicker production, especially in the lines of electrical tools, such as climbers, splicing clamps, electricians' drills, combination pliers, screw drivers, etc. The company expects to have about four times the present capacity, and needs it.

CONTINENTAL TELEPHONE CONSTRUCTION COMPANY is the name under which some Chicago parties have incorporated. They had at first intended calling it the Illinois Telephone Construction Company, and the matter was so announced. While the capitalization is but $2,500, they state that they are in a position to take contracts for building exchanges of any size and are now making arrangements for a large number of exchanges and toll line systems. The officers are: F. B. Patten, of Sandwich, Ill., president; H. Stromberg, of Chicago, vice-president, and Henry Shafer, of Chicago, secretary and treasurer.

NAVAL ESTIMATES.—The naval estimates for the coming year embrace several items for electrical improvements and apparatus. These include $5,000 for electric winches; $60,000 to commence the installation of a heat, light and power system, and $15,250 for electric elevators for the League Island Navy Yard; $15,000 for electric elevators, and $6,000 for electric light plant extensions at Boston; $20,000 for increase in the electric light plant at the Washington, D. C., Navy Yard, and $5,000 for the extension of the electric light plant at the Puget Sound naval station.

FIRE DEPARTMENT BIDS.—Bids were opened at Fire Headquarters, New York City, last week, for supplies and apparatus for the department, consisting of two new portable search-light engines, two 85-ft. trucks and 10,000 ft. of 2½-in. hose. The International Fire Engine Company, with offices in this city, secured the contracts for furnishing both the engines and trucks, bidding $6,500 each for the engines and $4,950 each for the trucks. The Peerless Rubber Company also secured contracts for hose supplies, etc.

THE COMSTOCK LODE.—The utilization of electric power on the Comstock lode has attracted considerable attention and was described recently in these pages. It is likely to lead to other work of the same character. The Truckee River is tapped for water power with two pairs of water wheels, each pair capable of supplying 1400 horse-power at 400 r. p. m. under a head of 84½ ft. The turbines are of the McCormick type, from S. Morgan Smith Company, of York, Pa., and the generators are Westinghouse.

STANLEY ELECTRIC MANUFACTURING COMPANY is very busy finishing its large new shops at Pittsfield. While in New York this week, President Perrine confirmed the report that the company had gone into railway work, and said that it was bidding successfully on railway generators and other large direct-current apparatus, in addition to its old polyphase work.

General News.

THE TELEPHONE.

ARKANSAS CITY, KAN.—The City Council has granted a telephone franchise to J. H. Montague.

OSCEOLA, ARK.—Mr. James G. Brewer, of this place, desires to purchase a good 75 to 100-drop switchboard.

GUADALAJARA, MEX.—A new telephone line is being constructed to connect this city with the town of Zapotlan.

ROME, GA.—Thomas S. Williams and associates have been granted a franchise by the City Council to operate a telephone line here.

LOWELL, MASS.—The Erie Telephone System made a net gain of 2107 subscribers in November. Total number connected Nov. 30, 139,321. Number waiting connection, 2853.

CHATTANOOGA, TENN.—The City Council has granted a telephone franchise to Thomas S. Wilcox and associates, who promise to establish an exchange here in the near future.

MEMPHIS, TENN.—C. W. Bolton, of Pontotoc, and L. B. Camp, of Amory, Miss., are building a telephone line between the two places named, to connect their exchanges. The distance is 20 miles.

HOLLANDALE, MISS.—Russell Bros. are putting in two 20-drop switchboards, one at Hollandale and the other at Belzoni, Miss. The boards are of the Utica Fire-alarm Telegraph Company's make.

SIKESTON, MO.—The Sikeston Telephone Company, of Sikeston, has been incorporated, with a capital stock of $12,000. Incorporators are: Geo. M. Head, Charles H. Sandu, John N. Chaney and others.

SEDALIA, MO.—Colonel Churchill, of St. Louis, is putting in a telephone system and the Missouri & Kansas Company has issued circulars asking its patrons to stand by it. A rate war is expected.

FOX LAKE. WIS.—A new telephone line from the west has reached this place, and now telephonic communication with Randolph, Cambria and other towns along the line is in order for the first time.

SANFORD, N. C.—Work has been started on a new telephone system here. The system will be built by Mr. Will Wynn, who proposes to connect Raleigh, Greensboro, N. C., and Richmond, Va., with Sanford.

HARRISONVILLE, MO.—The Cass County Telephone Company, of this city, with a capital stock of $2,000, has been incorporated. The incorporators are W. B. Scruggs, T. W. Clemmons, H. B. Moody and others.

MARYVILLE, TENN.—The Maryville Telephone Company will change its system to metallic. It now has about 140 subscribers and is increasing the number all the time. It has a switchboard capacity of 200 drops.

ROCKINGHAM, N. C.—The Rockingham Telephone Exchange has a capacity of 200 lines. It has 140 subscribers, of which 67 are of recent addition. It expects to add 60 more in the near future. Mr. J. G. Bundy is proprietor.

GEORGETOWN, S. C.—The Georgetown & North Island Telephone Company opened its exchange for the transaction of public business on Dec. 1, with about 60 subscribers. It has 20 miles of local circuit and 20 miles of toll line.

CANTON, OHIO.—The Stark County Telephone Company has finally succeeded in its fight against the Central Union Company and has secured a franchise for a local exchange. The company's rates will be $18 for residences and $24 for business offices.

CHATTANOOGA, TENN.—Mayor Joseph Wassman has announced that he affixed his veto to the ordinance which the city council recently passed giving certain parties the right to erect a telephone system in Chattanooga. The citizens opposed the ordinance.

INDIANAPOLIS, IND.—Bills to reduce the rates charged for telephone and telegraph service are being prepared. It is proposed to reduce the price for telegraph messages from 25 to 15 cents for the first ten words. Similar bills introduced in past legislatures met an early death.

DES MOINES, IA.—The Audubon County Telephone Company, which was recently organized, has exchanges at Audubon, Manning, Gray and Exira, with a total capacity of 188 drops. It is operating 18 miles of local circuits and 30 miles of toll line. It contemplates building 25 miles of line from Manning to Kirkman.

GOSHEN, IND.—The Home Telephone Company, of Elkhart County, has decided to construct a full metallic line from Goshen to Milford, there to connect with the Warsaw Independent Telephone Company's line recently purchased by Strauss & Co., of Ligonier, which firm will construct a direct independent line to Indianapolis.

MONTPELIER, OHIO.—During the last year the Montpelier Telephone Company has increased the number of its subscribers by 65, it now having a total of 149. Its ultimate switchboard capacity is 200 drops, of which 150 have been installed. The company expects to have 200 subscribers with six months. Mr. C. C. Lattamer is secretary.

CLEVELAND, OHIO.—The United States Telephone Company has completed a deal whereby it secures control on a 99-year lease of the long distance lines of the Pittsburg & Allegheny Telephone Company, thus opening the way for direct long distance service between Cleveland and Pittsburg and ultimately to Baltimore and other Eastern cities.

INDIANAPOLIS, IND.—The Indiana Electric Telephone Company has filed articles of incorporation with the Secretary of State. The company will operate telephone lines in Western Indiana and Eastern Illinois. The directors are Edgar Vansickle, C. E. Fair, J. G. Shane, C. S. Wolf, G. W. Fair and Anna Vansickle, all residents of Vermillion County.

ST. LOUIS, MO.—The Kinloch Telephone Company is rapidly extending in Illinois nearby towns. It has exchanges operating in Belleville and Collinsville. There are 300 subscribers in the former town and 150 in the latter. Exchanges are being established at Edwardsville, 200 subscribers; Alton, 300; Madison, Venice and Granite City, 200; St. Charles, 200.

BENTON, ILL.—A meeting of the Southern Illinois Telephone Association, which embraces all the independent companies of Southern Illinois, was held in Benton Nov. 23, in connection with a representative of the Kinloch Company, of St. Louis, with a view of arranging long distance connection from Southern Illinois towns to St. Louis and other distant points. A proposition was submitted to the Kinloch people which, if accepted, which is likely, connection will be made.

SAN FRANCISCO, CALIF.—City Attorney Franklin K. Lane recently rendered an opinion before the San Francisco Board of Supervisors to the effect that the city could not legally purchase an option upon the franchise and plant of the People's Mutual Telephone Company. The Public Utilities Committee recently considered the proposition of purchasing an option for one dollar. Mr. Lane holds that a special election must be held before such action can be legally taken.

CARROLLTON, GA.—The Georgia division of the Gainesboro Telephone Company is preparing to build an exchange at Villa Rica, Ga., where it expects to have 25 or 30 subscribers. The company has built metallic toll lines which are now in operation between Villa Rica and Carrollton, and Villa Rica and Bremen. At Villa Rica connection is available with Atlanta and other points on the Southern Bell system. The Gainesboro Company contemplates early extensions to Tallapoosa, Buchanan, Dallas and other towns.

CHATTANOOGA, TENN.—President J. E. Caldwell, of the Cumberland Telephone Company, announces that the company has purchased the Tri-State Telegraph & Telephone Company's plants and the plants of the North Alabama & Georgia Telephone & Telegraph Company and the North Georgia Telephone Company, all operating principally in the States of Georgia and Alabama. The system will be connected with the Cumberland in Chattanooga. The Cumberland system recently absorbed the East Tennessee system.

LOGANSPORT, IND.—A mass meeting was held in this city to discuss telephone franchises. The sentiment was largely in favor of an annual rate of $12 for residences and $18 for business houses. The Central Union is seeking an extension of its grant with no rate restrictions. Representatives of the Central Union and of the Indianapolis Independent Company, which wants a franchise for a local exchange, indulged in an acrimonious debate with a few personalities thrown in. Another meeting will be held before action is taken on the franchises.

NORTH WILKESBORO, N. C.—The Wil-Kin Electric Company has bought out the Wilkesboros Telephone Company and the Elkin Telephone Company and is now obtaining material for the construction of new lines. One of the lines will accommodate the local business and the other will be used for through service only. The exchange at North Wilkesboro has been enlarged and greatly improved. Several new telephones have been put in, and it will be necessary for the company to soon install another 100-drop switchboard to accommodate business at this place. Mr. H. W. Horton is manager here.

NORFOLK, VA.—The reported consolidation of the independent telephone and telegraph interests in Virginia and North Carolina hinges upon the establishment of connections between the lines of the Interstate Telephone & Telegraph Company, of North Carolina, and the Virginia Long-Distance Telephone Company. It is asserted that the two companies are now within about forty or fifty miles of each other, but that questions have arisen which will deter the merging of the smaller companies into the greater Independent Telephone Company, whose object was to offer combined opposition to the Bell.

MINNEAPOLIS, MINN.—The Mississippi Valley Telephone Company has again been having trouble with its creditors. The switchboard and general assets have been in the custody of the sheriff of Hennepin County, the "central" working under his direct supervision for several days. The attachments and extensions, however, are now satisfied by a $10,000 mortgage to E. H. Moulton and a judgment of $652.64 in favor of J. M. Dickson, of St. Paul. In all over $17,000 in debt was liquidated and the company is now free again. President J. C. Hubinger says that the system will be extended and improved with all the speed possible.

ATLANTA, GA.—It is reported that the Southern Bell Telephone & Telegraph Company and the Cumberland Telephone Company will be consolidated under a single management in the near future. Following this will occur a consolidation of all Bell systems, including the consolidated companies of the Cumberland & Southern Bell, the Chesapeake & Potomac, the Chicago, New York & Boston and all other systems under the direct management of the American Telephone & Telegraph Company, with headquarters at New York. It is further rumored that the Standard Company, after the first consolidation has been effected, will be absorbed in Atlanta by the consolidated lines and made a part of the system.

ELECTRIC LIGHT AND POWER.

ZIONSVILLE, IND.—This city is constructing an electric light plant at a cost of $16,000.

RICHMOND, IND.—Plans have been accepted and work begun on an electric light plant for this city.

RIO, WIS.—This city has awarded the contract for a complete electric lighting plant to J. Holt Gates & Co., of Chicago.

CITY OF MEXICO, MEX.—A new electric light plant is being put in at Guadalupe de Hidalgo, Mexico. It will soon be ready for operation.

CANYON CITY, ORE.—An electric company, with capital stock of $10,000, was recently organized to furnish lights in Canyon City and John Day, Ore.

PERTH, ONT.—The town of Perth has engaged Mr. William Kennedy, C.E., of Montreal, to design a power system for the electric light plant for this town.

JUNEAU, WIS.—The people of this city are considering the proposition to put in an electric lighting plant. The estimated cost is approximately $15,000.

RICHMOND, IND.—A destructive fire visited the Richmond Heat & Power Company's plant on Nov. 23, entailing a loss of $10,000, with $4,000 insurance.

STRUTHERS, OHIO.—A franchise has been granted to C. H. Struble, of Warren, Ohio, to install an electric lighting system and furnish light and power.

BELLVUE, KY.—An electric light plant in this place is projected. The city attorney has been instructed to bring in a resolution providing for this form of lighting.

ROSEBURG, ORE.—The Roseburg Water & Light Company has installed its generators and pumps in the Winchester power house. The pole line is nearly completed.

AYLMER, QUE.—This town has decided to issue debentures to the amount of $58,000 for the purchase of the electric light plant of the town and the installation of a water service.

MERIDA, YUCATAN, MEX.—A new electric light plant is being constructed at this place. The new system will provide private dwellings and business places with incandescent lights.

ST. LOUIS, MO.—A bill has been introduced into the City Council. to grant the Imperial Electric Light, Heat & Power Company a franchise to lay pipes through conduits in the streets.

TERRE HAUTE, IND.—The trustees of the Indiana State Normal School have asked the legislature for a specific appropriation of $8,000 for the installing of an electric light plant for the buildings.

OTTAWA, ONT.—The Ontario Department of Public Works has been urged to install an electric lighting plant. Such a plant would cost $15,000, but it is claimed that it would result in a saving of $2,000 per annum.

QUERETARO, MEX.—The American Engine Company has sold the electric light plant at Queretaro to Antonio Loyola, a citizen of this place. Thomas E. Sims, formerly of the City of Mexico, is chief electrician of the plant.

THESSALON, ONT.—The Town Council has just taken tenders for the supply of an electric lighting plant of 1000 lights. A by-law to raise the necessary funds for the purpose of installing an electric light plant has been passed.

SAN FRANCISCO, CALIF.—The Chollar and Potosi mining companies on the Comstock Lode, Nevada, are wiring the main tunnel and will install a 30-hp electric motor. Electric light and power will soon be supplied to these works.

STEAMBOAT SPRINGS, COLO.—The Town Council has granted a 20-year electric light franchise to G. H. Smedley. The plant will be a 440-volt, three-wire system, using 220-volt lamps. The streets will be lighted exclusively by arc lamps.

SAN FRANCISCO, CALIF.—The Yellow Jacket mining works on the Comstock Lode are being prepared for operation by electricity. A new air compressor is being installed, and also two electric hoists. The works are already lighted by electricity.

WOODSTOCK, ONT.—The property owners of this town have voted on a by-law to authorize the expenditure of $30,000 on the purchase and improvement of the electric light plant. The result was a decisive victory for the advocates of municipal ownership.

HOBSONVILLE, ORE.—The electric sawmill near Hobsonville, Tillamook County, Ore., was recently carried away by a flood in the stream on which it was situated. The electric power station, which supplied current to operate the motors in the mill, was not injured.

KINGSTON, ONT.—The civic lighting committee will recommend the corporation to establish a municipal electric light plant, at a cost of $50,000, rather than arbitrate for, and probably not purchase, the present plant owned by the Kingston Electric Light Company.

HELENA, MONT.—The Missouri River Power Company, which recently absorbed the Helena Water & Electric Power Company, has paid in $500,000 cash to complete the electric line to Butte. This line will be 66 miles in length and will carry 4000 horse-power to Butte.

CITY OF MEXICO, MEX.—The State Government of Nuevo Leon, Mexico, has granted a concession to Melchor Zepeda, of Sabinas Hidalgo, that State, for the establishment of an electric light plant at that place. The plant will be exempt from all taxation for a period of twelve years.

WELDON, N. C.—Maj. James W. Wilson is building the 1000-hp electric plant at the Roanoke Navigation & Power Company's works at Roanoke Rapids, near Weldon. It will supply power for the silk and cotton mills of the Putnam Textile Company, two and one-half miles away; also light for Weldon.

SAN FRANCISCO, CALIF.—The Beckwith Power Company was recently incorporated to deal in water for power purposes, etc. Principal place of business, San Francisco. Directors: B. D. Beckwith, Colusa; Don Ray, C. Ray, Galt; W. M. Pierson, S. C. Denson, San Francisco. Capital stock, $750,000; subscribed, $250.

CITY OF MEXICO, MEX.—The formal inauguration of the new electric light plant in the city of Victoria, the capital of the State of Tamaulipas, Mexico, will occur on Dec. 31. The plant is being put in by Manuel Gonzales, son of the late ex-President Gonzales. Power for the plant will be furnished by the falls at Tamatan, about two miles from Victoria.

LOGANSPORT, IND.—It has been plainly demonstrated that the municipal light plant cannot maintain itself and keep up needed improvements on the present rate of 5 cents per kilowatt. An ordinance has been introduced providing that no consumer shall pay less than 75 cents a month for lighting service. If this fails the rate will be raised to 7 cents per kilowatt.

NEWPORT NEWS, VA.—Mayor Moss has vetoed an ordinance contracting with the new Consumers' Light, Heat & Power Company to supply 50 arc lights because of a proposition from the old company to reduce the price of all the present lights to $50 per year and to furnish all new ones at the same figure. The Consumers' Company, it is stated, will contest the matter.

CINCINNATI, OHIO.—Cincinnati electric concerns are somewhat agitated over the possibility of a move toward municipal electric lighting. A rumor was circulated that the Board of Legislature had in preparation a resolution to advertise for bids for a building and equipment. In the meantime a battle to the death is on between the gas company and the Edison Electric Light Company.

SAN FRANCISCO, CALIF.—The Comstock Pumping Association, composed of a number of large mining companies, recently made the final $25,000-payment on the $100,000-bonus which was promised to the Truckee River General Electric Company upon the completion of its transmission system to supply the Comstock with cheap power. The money will be rebated on payments for power.

CITY OF MEXICO, MEX.—The Mexican Government has granted a concession to Augustin Gastinel, Augustin Arnaud and Francisco Urquiza, prominent capitalists, giving them the exclusive right to utilize the waters of the Lerma River, in the district of Maravatio, State of Michoacan, for an electric power plant. The power thus generated will be transmitted to a distance and used in manufacturing enterprises.

ARGENTINE REPUBLIC.—The River Plate Electric Light & Traction Company, at Rosario, Argentine Republic, has prepared plans for its installation in accordance with the decision of the Arbitration Court. The work will cost $475,000. The actual system of alternating current is to be changed to continuous current. All the mains in the central streets will be underground. Quantities of new machinery and material will be required by the company for the change.

FAYETTEVILLE, N. C.—The Board of Aldermen has decided that as the Cape Fear Power Company would be unable to fulfill its contract to furnish lights to Fayetteville by Jan. 1, 1901, that the municipal authorities should proceed to the disposal of the light bonds and the erection of a power plant, and further recognizing the great benefits to accrue from the Cape Fear Power Company when it should complete its enterprise, that the option on this plant should be offered to hold good until Jan. 9, 1901.

PORT ARTHUR, ONT.—Messrs. George Hodder and J. D. King have reported to the Town Council in regard to the development of the Current River water-power for electric light and street railway purposes. The total cost is estimated at about $30,000, and includes $15,000 for building dam, excavations, flumes, water wheels and addition to power house; $6,000 for electric light plant, and $2,000 for a power generator. It is recommended that a by-law be submitted to the ratepayers of the town to raise the necessary funds.

SAN FRANCISCO, CALIF.—The Mammoth Electric Company, recently organized at Hanford, Calif., will build a hydraulic electric power transmission plant on the San Joachim River, and is now surveying the route for the conduit. Estimates are now being prepared for the hydraulic and electric plants. Nothing definite, however, has yet been settled on as to the plan that will be finally adopted. The company has over 66,000 theoretical horse-power at lowest water mark. The incorporation of this company was recently noted in these columns.

PANA, ILL.—Robert Johns, who owned the controlling interest in the Pana Modern Electric Light & Street Railway Company one year ago, deeded to a Chicago syndicate, in consideration of the sum of $100,000, all the rights of the company in Pana, together with the franchises. As a consideration 55,000 acres of West Virginia lands were taken in part payment. Mr. Johns at the time of filing the deed for record failed to put the necessary amount of revenue stamps on it. The recorder returned the deed, and while it was in transit outside parties filed a judgment against the lands. A few days ago the electric light company attempted to move the machinery from the building, and in the absence of Mr. Johns an attachment was served by his wife, restraining the electric light company from removing any machinery from the plant.

THE ELECTRIC RAILWAY.

SHEBOYGAN, WIS.—The Sheboygan Street Railway Company will extend its line from Sheboygan Falls to Plymouth.

WABASH, IND.—F. C. Boyd, of the Wabash River Traction Company, which is to build the Wabash-Peru Interurban line, is making contracts for grading, ties, etc.

WAPAKONETA, OHIO.—A company, headed by Lima people, is securing a right of way for an east and west road through this place extending from Kenton to Celina.

VINCENNES, IND.—The managers of the Citizens' Electric Railway of this city have discovered that counterfeit tickets fares have been used on their line for some time.

ZANESVILLE, OHIO.—Citizens have started a crusade against the Zanesville Street Railway Company, claiming that its lines are more of a nuisance than a convenience.

KEY WEST, FLA.—The strike of the motormen and conductors of the electric street railway system in this city has been settled, and the cars have resumed their schedules.

MEMPHIS, TENN.—The Memphis Street Railway Company will in the near future add to its equipment two Corliss engines of 4000 horse-power and two new generators of 850 kilowatts each.

GRAND RAPIDS, MICH.—The new power station for the Grand Rapids Company at Grand Rapids, Mich., will be 111 ft. wide and 147 ft. long, furnished by the American Bridge Company.

CHICAGO, ILL.—The Illinois Supreme Court denied the petition to compel the Secretary of State to issue a charter to the Citizens' Street Railway, on the ground that it has no capital stock.

PUEBLA, MEX.—A new street railway has just been completed from Puebla to the Cerro de San Juan. There is a plan on foot whereby the city of Puebla shall obtain control of this new road.

LEBANON, OHIO.—The Warren County Commissioners have granted a franchise to a company headed by James B. Swing for an electric railway, to run from Dayton to a point near Cincinnati.

McKEESPORT, PA.—The McKeesport (Pa.) Wilmerding & Duquesne Street Railway and Youghiogheny Valley Traction Company have been sold to the Monongahela Street Railway for $600,000.

LIMA, OHIO.—The Lima & Findlay Electric Railway Company has been incorporated by T. D. Robb, J. D. S. Neely, Louis Koch, Frank Seiber and A. D. Miller. The temporary capital stock is $20,000.

INDIANAPOLIS, IND.—The County Commissioners have granted John J. Rockford and other local capitalists a franchise to construct and operate the Indianapolis, Morristown & Rushville electric line.

FORT WAYNE, IND.—Lewis B. McIlheiny, of Dayton, Ohio, has been granted an electric interurban railway franchise at this place and a line will be built to Decatur and eventually from there to Dayton, Ohio.

ST. PAUL, MINN.—The St. Paul water board will begin at once a thorough investigation to determine the extent of the damage done to the city water system by electrolysis, and then take prompt steps to find a remedy.

CANTON, OHIO.—The Stark County Commissioners, who two weeks ago declined to grant a franchise to T. L. Childs, promoter of the Akron-Canton road, have reconsidered their action and granted the desired permission.

TERRE HAUTE, IND.—Because the interurban line between this city and Seeleyville charged 20 cents for the round trip, 40 miners living here have contracted with a bus man to haul them to and fro for $2 a month each.

CLEVELAND, OHIO.—The stockholders of the Cleveland & Chagrin Falls Railway Company have decided to build a club house and summer resort at Horseshoe Glens, on the line of road, about four miles from Chagrin Falls.

FT. WAYNE, IND.—George Townsend, William Reed and C. C. Miller, the capitalists backing the proposed electric railway from this city to Huntington, have purchased a stretch of 15 miles of the old Wabash and Erie canal bed.

MEXICO.—Several capitalists of Tampico have formed a company for the construction of an electric railroad which, starting from the centre of the city, will end at La Barra, passing by Doña Cecilia. This line will be about 10 kilometers in length.

ATLANTA, GA.—The city council committee on electrical and other railways have determined to recommend to the council to grant franchises to the Atlanta Rapid Transit Company on a number of streets, in response to an application from the company.

XENIA, OHIO.—The Little Miami Traction Company, of Xenia, has been incorporated with $50,000 capital stock by John P. Martin, of Xenia; Chas. J. Christie, of Cincinnati; W. E. Hutton, Chas. Orr and Rufus P. Ranney, of Cleveland; W. D. Riddell, of Xenia, and R. L. Andrews, of Cleveland.

SAN ANTONIO, TEX.—The Alamo Heights Railway Company, of San Antonio, which was recently sold at receiver's sale, has been reorganized and chartered under the name of the Grand Avenue Railroad Company. The new owners propose to rebuild the line and to provide it with new equipment throughout.

BRAZIL, IND.—The employees of the East End Division of the Brazil-Terre Haute Electric Railway, who struck because they were required to act both as motormen and conductors by collecting fares, have returned to work on the agreement of the management to put in the slot-cash box service.

LEBANON, IND.—The Lebanon & Indianapolis Traction Company, which was recently granted a 50-year franchise by the Marion County Commissioners over the Lafayette pike, has been granted a franchise on the Lebanon pike through this county. Cars are to be running by May 1, and the company is to pay $25 per mile annually to the county.

COSTLY HUMILIATION.—Frank G. Moon considers that he has been humiliated to the extent of $5,000 by a St. Louis street car conductor, and has filed suit for that amount against the St. Louis Transit Company. In his petition he states that he paid his fare with five pennies, and the conductor at first took them, but later came back and threw them in his face, while 25 passengers looked on, much to his discomfiture and humiliation.

KENOSHA, WIS.—The Milwaukee Light & Traction Company has made a new proposition to the special committee of the City Council, offering a cash bonus of $15,000 if the franchise is passed allowing it to construct its lines through the city. The committee declined to accept the proposition, and the company will take it before the entire Council.

AKRON, OHIO.—The Akron & Cuyahoga Falls Transit Company has been sold out to a syndicate composed of Andrew Radel, of Bridgeport, Conn.; Judge Gottfried Krueger, H. M. Doremus and William Sheerer, of Newark, N. J., and E. H. Radel, of Orange, N. J., all of whom are interested in electric railway enterprises in the East. The company operates three lines from this city, extending to Cuyahoga Falls, Kent and Barberton, respectively; in all, about 50 miles of track.

SANDUSKY, OHIO.—The Sandusky, Norwalk & Southern Electric Railway Company, which has absorbed the Sandusky, Milan & Norwalk Railway and the White Line of this city, has organized as follows: Directors—Truman B. Taylor, John Whitworth, George F. Butler, Jacob Kuebeler, Frank Stang and Abram Lebensburger, of this city; Henry Kelly, of Milan, and L. B. Dennis and S. E. Crawford, of Norwalk. Officers—Truman B. Taylor, president; John Whitworth, vice-president; Emil G. Schmidt, treasurer and general manager; W. E. Guerin, Jr., secretary; Edward Adams, general superintendent; H. G. Miller, auditor, and George R. Butler, T. B. Taylor and John Whitworth, executive committee.

BELLEVILLE, ONT.—Messrs. Dean, Shipley & Company, of New York, have acquired the electric street railway franchise at Belleville for 20 years, with the option of a renewal for another term of 20 years, subject to the readjustment of rates every 10 years. The firm also acquires the electric light franchise for 40 years, as well as the gas company's plant, with renewal of franchise for 50 years. The purchasers have undertaken to reduce the cost of street lighting to $65 per lamp per year, to extend the electric railway, to lower gas rates 25 cents per 1000 ft. (viz., to $2), and to supply 1000 electrical horse-power for manufacturing purposes to the city at a schedule of prices laid down. Bonds will be issued by the firm for $450,000 to carry out its scheme. The firm is also negotiating for power at Campbellford, Ont.

MANSFIELD, OHIO.—The Citizens' Street Railway Company, which is building a line to Shelby, will make some extensive improvements to its power house in this place. The plant will be equipped for city lighting as well, and contracts have been placed for considerable new machinery. The Card Electric Company, of Mansfield, will furnish two 400-hp railway generators and a 150-hp booster, and the Warren Electric Company, of Sandusky, two alternating machines, each with a capacity of 5000 lights. The Bates Engine Company, of Joliet, Ill., will furnish an 800-hp Corliss engine, while the Aultman & Taylor Company, Mansfield, will install two 250-hp boilers. The total engine capacity will be about 1500 horse-power, of which 1000 horse-power will be used for railway purposes. The company will place contracts for a number of interurban cars in the near future.

THE AUTOMOBILE.

THE SCOTT AUTOMOBILE COMPANY, organized in St. Louis a short time ago, with a capital stock of $30,000, has commenced its new building at 3935 Olive Street, and will be in working order in about 30 days. Chas. R. Drummond is president; L. S. Scott, vice-president, and W. Daviess Putnam is secretary. Two styles of electric automobile will be manufactured—a runabout and a stanhope. The runabout will be equipped with a 45-mile battery and the stanhope with a 55-mile battery.

HOTEL AUTOMOBILES.—Mr. Jas. E. Galbrey, manager of the Cochran Hotel, Washington, says: "We have been operating a 'bus furnished by the Washington Electric Vehicle Transportation Company for nearly two months, and find that it is in every way well adaptd to our use, the service rendered being satisfactory alike to the hotel and its guests. The work has been prompt and convenient, as well as practicable and most useful for hotel 'bus purposes, and we are entirely satisfied with the results and our contract with your company." In the same tenor, Mr. T. E. Roessle, proprietor of the Arlington, writes to Mr. W. T. Headley, superintendent, at Washington: "Our two months' experience with your electric omnibus has been in every way most satisfactory, both to the hotel, and, so far as I can learn, to the guests also, and it is a service that I regard as an improvement and an advancement over the old methods."

NEW INDUSTRIAL COMPANIES.

THE AUTO TOOL COMPANY, of New York City, has been incorporated in Delaware. Capital, $600,000.

THE PHILADELPHIA MESSENGLR 'PHONE CALL COMPANY has been incorporated at Wilmington, Del., with a capital stock of $100,000.

THE NATIONAL MANUFACTURING & ELECTRIC COMPANY, of Assumption, Ill., with a capital stock of $25,000, has been incorporated. The incorporators are C. C. Corzine and I. H. Cushing.

THE TANGENT GRIP PULLEY COMPANY, of Jamestown, N. Y., has been incorporated with a capital of $20,000. Directors—F. W. Gurney and T. W. D. Addenbrook, of Jamestown, and J. R. Sage, of Oberlin, Ohio.

LEGAL.

TELEPHONE RIGHTS IN DULUTH.—Judge Lochren in a case involving the right of the Duluth Telephone Company to do business in the city of Duluth has decided in effect that the company has a perpetual franchise in the city of Duluth under the State law, and the same must be true of every other telephone company in the State. The franchise of the telephone company had expired and it claimed the right to do business under the State law, which granted to telephone companies the right to maintain their wires and poles on public roads and highways in the State. The city has sought to oust the company and prevent it from doing business in the State.

TELEGRAPH TAX IN NORTH CAROLINA.—The Attorney General of North Carolina has just rendered an opinion of considerable importance to telegraph companies. The existing law imposes a tax of 2 per cent on the gross receipts of these companies within the State, and State Treasurer Worth recently took the position that the law applies to all the receipts of the company collected for tolls in the State. The Attorney General informs the treasurer that while his interpretation of the law, as written, is correct, the law is clearly unconstitutional in its application to receipts for tolls collected on messages sent outside of this State; that the receipts from messages between points within the State only are subject to the tax in question.

OBITUARY.

FRANK R. STEELE, local manager of the Western Union Telegraph Company in San Francisco, died suddenly from heart disease Dec. 1. Mr. Steele was for 25 years in the service of the company. A wife and two children survive him.

MR. EASTWOOD EASTWOOD, president of the Rhode Island Electrical Works, of Pawtucket, died on Saturday, Dec. 1, at his home in Central Falls, R. I., from blood poisoning. He had been president of the company since its organization; he was also an active member of the R. Plew Manufacturing Company, and was mayor of Central Falls. The funeral took place on Tuesday, Dec. 4.

PERSONAL.

MR. CHARLES E. YERKES, son of Charles T. Yerkes, has been elected president of the Lake Street Elevated Railroad, Chicago.

PROF. H. T. BOVEY and Prof. R. B. Owens, of McGill University, were in New York last week attending the meeting of the Mechanical Engineers, etc.

MR. J. B. PEVEAR, acting manager of the Cincinnati office of the General Electric Company, left Sunday night, Dec. 9, to attend the annual meeting of the company's managers in New York City.

MR. W. L. STOCKON, representing the Western Electric Company, which is putting in an electrical apparatus for the Ottawa Electric Company, is in Ottawa in connection with the work.

MR. PETER COOPER HEWITT has been working for some time past on newer methods of vacuum tube lighting, and the newspapers this week have heralded his production of a commercial "vapor light" at his Madison Square laboratory. Mr. Hewitt admits modestly that he is still on the road to it.

MR. H. C. WYBRO, manager of the Wybro-Hendy Company, recently returned to San Francisco from New York. While in the East he secured a large contract for the Bullock Electric Company—the three-phase transmission plant for the McCloud River Electrical Power Company, Keswick, Calif.

MR. MORRIS W. MEAD, superintendent of the electrical department of Pittsburg, met with an accident the other day, which will make it necessary for him to be confined to his home for several weeks. While climbing a ladder one of the rungs gave way, precipitating him to the ground. One of his legs was broken by the fall.

MR. ADOLPHE A. CHAILLET, has resigned his position as technical manager of the Shelby Electric Company, and has opened an office as consulting electrical and mechanical engineer in the Ellicott Square Building, Buffalo. He remains as technical adviser of the Shelby Company and will represent its lamp in that part of New York State.

MR. W. F. HAYS, who was until a few months ago the manager of the General Electric Company's business in Cincinnati, is now at his old home, in Augusta, Ky., a wreck of his former self, and grave fears are entertained that he will never regain the use of his mental faculties. Mr. Hays, at the time of his misfortune, was the youngest of the General Electric Company's branch managers and counted one of the brainiest men in the employ of the company. His friends throughout the country, who are legion, hope for his early recovery.

MR. JAMES PARMELEE has been elected president of the National Carbon Company, to succeed the late Washington H. Lawrence. Mr. Parmelee has been vice-president of the company since its organization. To fill the vacancy caused by the elevation of Mr. Parmelee, Col. Myron T. Herrick was elected vice-president. The newly elected president is treasurer of the Wheeling & Lake Erie Railroad Company and a resident of New York. He was formerly a Clevelander and with Col. Myron T. Herrick and W. J. Crawford constituted the firm of Herrick, Parmelee & Crawford, which deals extensively in real estate and has been engaged in electrical enterprises.

MR. D. H. LOUDERBACK.—There is considerable interest in London as to who will succeed D. H. Louderback, of Chicago, as the special representative of Charles T. Yerkes there. Mr. Louderback is still actively engaged in Mr. Yerkes' interests, and is confident of closing up successful contracts before leaving England. "I am naturally disinclined to talk about the plans," he said recently, "as the matter must now be left to my successor, whose name will undoubtedly be announced in the United States in the course of a few days. It is a source of great regret to me that my wife's illness compels me to leave work which offers so many interesting features. London, no doubt, will prove a great field for electrical enterprise in the next few years, and the Americans are sure to figure prominently in it."

Trade Notes.

ENGINE GOVERNORS.—The Ideal engine governor is described and illustrated in a bulletin just issued by A. L. Ide & Sons, Springfield, Ill.

MR. ROBERT McOUAT, of Indianapolis, Ind., reports large sales of cross arms, pins and brackets; also leather nail heads and Varmack dry batteries.

THE LUNKENHEIMER COMPANY, Cincinnati, Ohio, will be ready to announce within three or four months the introduction of a brand new gasoline automobile.

THE STEWART ELECTRIC COMPANY, Cincinnati, Ohio, is now settled in new quarters in East Fifth Street, taking a place two or three times as large as the former quarters. Its specialty is electrical repairing.

THE AMERICAN CLAY WORKING COMPANY has decided to rebuild its plant at Willoughby, Ohio, which was destroyed by fire some time ago. Electric power will be used, and a 20-ton electric crane will be installed.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports business increasing perceptibly. Two recent orders are from Philadelphia and New York. A St. Louis order is for a 200-kw, three-bearing belted generator for the Laclede Gas Company.

ELECTRIC FIRE PROTECTION.—The North German Lloyd Steamship Company will install in all of the pier structures now being erected at Hoboken, N. J., a complete system of electric fire alarms. It will employ for this purpose the Montauk multiphase cable system.

THE BROWNING MANUFACTURING COMPANY, Milwaukee, Wis., a short time ago put on the market small power motors ranging from 1-12 horse-power to 1½ horse-power. The company has experienced a heavy demand for its motors and has lately received an order from London, England, for 50 motors.

THE STEPHENSON MANUFACTURING COMPANY, of Albany, N. Y., reports that its belt-dressing is becoming quite popular abroad. It has shipped it to several foreign countries during the past year, and says that as it is a case of "once used—always used" it looks for a good export trade.

THE ELECTRIC APPLIANCE COMPANY, Cincinnati, Ohio, has gone into the manufacturing business exclusively. It has taken larger quarters and is making storage batteries and telephones for all systems. A novelty is a watchcase receiver which is built upon a new principle, and is exploited as a very clever invention.

TRANSFORMERS.—The General Electric Company through its Cincinnati office has just closed a contract with the Ohio Valley Street Railway at Ashland for two constant-current transformers for street lighting, each 14½ kilowatts. The same company has contracted with Ashtabula, Ohio, for two constant-current transformers for the same purpose, each of 25-kw capacity.

THE DEVERE ELECTRIC COMPANY, Cincinnati, Ohio, has just finished the installation of two big plants in Springfield, Ohio, one of which was for the Bookwalter Hotel. The work includes wiring for light, telephone and entire electric service throughout. Another large contract just finished was the installation of a conduit system in one hundred rooms at the Mt. Adams Monastery, Cincinnati.

FISHKILL CORLISS ENGINES are described and illustrated in a 42-page pamphlet of the Fishkill Landing Machine Company, Fishkill-on-the-Hudson, N. Y. The special merits of these engines consist in economy, close regulation and noiseless operation. In this machine the manufacturer claims that all of the best features of the original Corliss engine, with some valuable improvements, are combined.

GAS ENGINE IGNITERS.—Those interested in the problem of gas engine ignition will find valuable and instructive reading in a pamphlet issued by the Dayton Electrical Manufacturing Company, Dayton, Ohio. In this pamphlet is described the Apple gas engine igniter, which was recently described and illustrated in these columns. These igniters are made to operate with either touch or jump spark.

MR. H. J. LINDER, of H. J. Linder & Company, 123 Liberty Street, New York, has just returned from England, having been there since Oct. 1. He reports having had a very successful trip, having closed up some good contracts, and states that the field for electrical goods of American manufacture is only just opening up. Good prices are to be had for worthy goods and money is plentiful, insuring prompt payment.

TELEPHONE CATALOGUE.—The Central Telephone & Electric Company, 909 Market Street, St. Louis, Mo., illustrates and describes its complete telephones and switchboards in a recently issued catalogue of 16 pages. This company is producing the latest and most novel constructions in telephone apparatus, and in order to acquaint telephone users with its product it will ship to any responsible person in the United States one pair of its telephones on a 15-day trial. The company manufactures to order any special designs of apparatus or switchboards.

DIRECT-CONNECTED MOTORS.—The use of direct-connected electric motors for operating printing presses is steadily increasing. A recent number of *Cassier's Magazine* contained illustrations of a number of large printing plants using electric power, among them being the International Correspondence Schools, Scranton, Pa. The schools have 10 cylinder presses and a number of job presses, wire stitchers, folding and cutting machines, each operated by a separate motor. The plant, which is of considerable interest to both printers and electricians, may be visited at any time by any one interested.

THE STEAM LOOP.—A very handsome pamphlet has been issued by Westinghouse, Church, Kerr & Company, describing the steam loop and Holly gravity return system, which, as is well known by all engineers, is a system for returning the condensation of hot water from steam pipes to the boilers, the water returning at practically boiler temperature. The pamphlet is very artistically illustrated with full-page views of plants in which this system is in use. It is also employed on some ocean steamers. Among the plants illustrated are several electric generating stations in different parts of the country.

SPRAGUE ELECTRIC COMPANY.—Owing to a constantly increasing demand for its products, the Sprague Electric Company has been obliged to increase greatly the floor space in the New York office, which is now located on three floors of the factory. The New York factory is devoted exclusively to the manufacture of the various lines of interior conduit and appliances which have brought the art of electric wiring to an absolute simplicity. The company operates a still larger plant in Bloomfield, N. J., where are manufactured all the light and power apparatus, such as generators, motors, fans, elevators, hoists, etc. A new branch office will be opened soon.

THAT DEVIL! DOUBT is the title of a 48-page pamphlet of attractive get-up just issued by the Emerson Electric Manufacturing Company, St. Louis, Mo. Its purpose is to set at rest any doubts that may exist in the minds of central station managers as to the satisfactory operation of single-phase alternating current motors. It aims to accomplish this by presenting facsimiles of testimonials from actual users of these motors. There are 21 testimonials on desk and ceiling fans and 23 on power motors. Besides these there are a few extracts from foreign letters. This mass of testimony will certainly make an impression upon those for whom the pamphlet is intended.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY will soon complete a large addition to its machine shop and a building to provide for the brass foundry and boxing and brass polishing departments. When occupied they will so increase the floor space and improve the facilities to such an extent that the capacity of the works will be nearly doubled. Many large contracts have been recently received from both home and abroad, and the company states that the present outlook for business during 1901 is even better than during the past four years. It has recently issued bulletin No. 37, which gives a list of the purchasers of Bullock apparatus, shows numerous views in the works and the various types of machines manufactured.

ELECTRIC FUSES.—The American Electric Fuse Company, Chicago, Ill., is issuing a little pamphlet showing the manner in which fuses, fuse-blocks, lightning arresters and other of this company's specialties are made and how they should be used. It has been compiled with great care and will be of assistance in a great many cases in locating the source of trouble and in preventing loss or damage that might otherwise result. Any one can secure a copy of the pamphlet by addressing the company at 345 South Canal Street. The company has recently adopted a new rule, by which it guarantees for one year everything it manufactures, offering to pay all expenses of the shipment or other charges in case any of its goods are found to be in any respect defective.

THE NORTHWEST FIXTURE COMPANY, Seattle, Wash., has recently moved into its new premises, 313 First Avenue, South. The entire building, four stories and basement, has been purchased by the company and will be used exclusively by it. The basement will be fitted for heavy stock and the first floor for retail; the second will be given over to mantels, grates, fixtures, fittings, etc.; the third will be used for the storage of glassware, light supplies and shelf goods, and the fourth will be the manufacturing department, which will be one of the most complete and best equipped on the Pacific Coast. President A. L. Kasson, of the company, has lately returned from a trip to Alaska, where there are many customers. The company's Eastern purchasing department, represented by Mr. C. J. Purdy, 26 Cortlandt Street, New York, is at present shipping three carloads per month of machinery to Seattle headquarters.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 4, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

662,911. ELECTRIC HEATER; J. E. Brown, Philadelphia, Pa. App. filed Jan. 24, 1900. The box containing the heater is provided with brackets or ears having slots into which the heating coil is inserted.

662,921. APPARATUS FOR ELECTRIC TRACTION; H. Dolter, Paris, France. App. filed July 6, 1899. A box containing a pendulum circuit closer, which is elevated and swung by a magnet carried by the car to close the circuit from the feeder.

662,928. SPACE BLOCK FOR ARMATURES; H. Geisenhoner, Schenectady, N. Y. App. filed Jan. 18, 1900. The space block is designed to afford ventilation; it comprises a flat core plate punched to receive a space piece secured thereto edge on.

662,931. ELECTRIC ARC LAMP; F. A. Gilbert, Brookline and E. O. Lundin, Beachmont, Mass. App. filed July 22, 1898. The clutch is mounted upon a tube through which the upper carbon passes, and means are provided to prevent lateral movement of the clutch, the clutch acting as the only guide for the carbon.

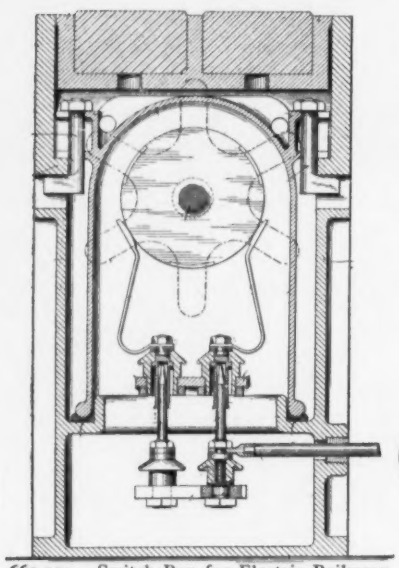
662,979. AUTOMATIC MAGNETIC CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed April 27, 1900. The movable portion comprises two members forming a main and a secondary path for the current, the secondary member being first to make the circuit upon the closing of the switch and last to break it upon opening.

662,984. TELEPHONE EXCHANGE SYSTEM; A. Stromberg, Chicago, Ill. App. filed Oct. 18, 1899. (See Current News and Notes.)

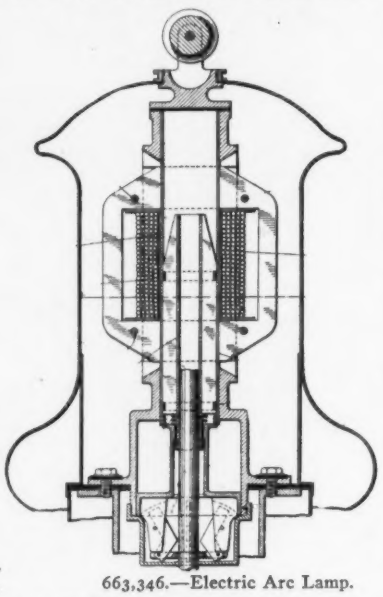
662,985. TELEPHONE TRANSMITTER; A. Stromberg, Chicago, Ill. App. filed Feb. 24, 1900. (See Current News and Notes.)

662,986. TELEPHONE EXCHANGE SYSTEM AND APPARATUS; A. Stromberg, Chicago, Ill. App. filed June 6, 1900. (See Current News and Notes.)

662,987. CIRCUIT PROTECTOR; A Stromberg, Chicago, Ill. App. filed June 28, 1900. The grounded terminal of a lightning arrester is opposed to the fuse, the fuse constituting the second lightning arrester terminal. The fuse is stretched across the face of the terminal, which is of carbon, and the terminal is partially covered with insulating material to prevent actual contact.



663,232.—Switch Box for Electric Railways.



663,346.—Electric Arc Lamp.

662,988. TELEPHONE EXCHANGE SYSTEM; A. Stromberg and W. M. Davis, Chicago, Ill. App. filed June 28, 1900. (See Current News and Notes.)

662,992. ELECTRIC CURRENT INDICATOR; H. M. Warren, Schenectady, N. Y. App. filed Dec. 9, 1899. (See Current News and Notes.)

662,995. ELECTRIC ARC LAMP; O. N. Wiswell, Lynn, Mass. App. filed May 4, 1899. The feed magnet has a pointed pole-tip and an armature surrounding the pole-tip, the pole having an enlargement of magnetic material at or near the feeding point for exerting a sharp increase of pull.

662,996. ELECTRIC ARC LAMP; J. J. Wood, Fort Wayne, Ind. App. filed Dec. 4, 1899. The principal object of this invention is to obtain sensitive feeding of the carbon and this is accomplished by the use of two magnets, one for feeding and the other for separating the carbons, and a resistance coil arranged as a shunt short-circuiting both magnets and cut in or out by a contact device operated under certain conditions by either magnet.

663,015. ELECTRIC METER; T. A. Edison, Llewellyn Park, N. J. App. filed March 17, 1899. (See Current News and Notes.)

663,039. FLUSH SWITCH SUPPORT; C. G. Perkins, Hartford, Conn. App. filed June 28, 1900. The invention resides in a frame or box so constructed, and a switch receptacle or receptacles so shaped, that after the frame or box has been fixed in position in the wall of the building the receptacle or receptacles containing the switch mechanisms may be conveniently located and firmly secured in place without the employment of the holding plate now commonly used.

663,043. RETURN SIGNAL DEVICE FOR CALL BOXES; J. S. Robinson and H. M. Robinson, Chicago, Ill. App. filed Feb. 12, 1900. A construction which will, during or after the call has been sent, switch the circuit through a magnet and through the medium of such energized magnet prevent the return signal devices in the box from operating until the circuit is open.

663,059. AUTOMATIC ELECTRICAL APPARATUS FOR INDICATING LEAKS IN SHIPS; W. W. Zvorikin and S. De Blumenthal, Moscow, Russia. App. filed March 24, 1899. When water leaking into the vessel reaches a circuit breaker the fact is indicated and the signal operated. By a special arrangement of circuits the pump is automatically set into operation.

663,075. SPACE BLOCK FOR ARMATURES; H. Geisenhoner, Schenectady, N. Y. App. filed July 28, 1900. A modification of the device described in patent No. 662,928.

663,082. FIRE ALARM TELEGRAPH APPARATUS; W. H. Kirnan, Bayonne, N. J. App. filed Oct. 4, 1899. The object of this invention is to provide an apparatus by which the signal received at the central office will be sent out by the joker transmitter immediately upon its receipt and without requiring a complete round of the signal to be first receiver at the central office, thus avoiding loss of time.

663,095. INCANDESCENT BODY FOR ELECTRIC-GLOW LAMPS; A. Just, Vienna, Austria-Hungary. App. filed Sept. 20, 1900. (See Current News and Notes.)

663,130. ELECTRICAL APPARATUS FOR CONTROLLING SIGNAL OR OTHER CIRCUITS; H. A. Parrish, Jackson, Mich. App. filed Aug. 11, 1899. Details of apparatus for preventing the waste of battery and unwarranted closure of the circuit of railway crossing signals.

663,196. TELEPHONE RECEIVER; C. H. North, Cleveland, Ohio. App. filed Nov. 15, 1899. (See Current News and Notes.)

663,198. CLIP OR SUPPORT FOR TROLLEY WIRES; W. H. Russell, Watertown, Mass. App. filed March 20, 1900. The clip is provided with a curved groove, in which the wire is clamped to prevent the wire from slipping through the clip.

663,207. MEANS FOR STARTING OR STOPPING ELECTRIC MOTORS; J. J. Wood, Fort Wayne, Ind. App. filed July 11, 1899. Comprises a rheostat and its arm and an electromagnetic detent for holding the arm in the normal running position, a switch, and an actuater distinct from the switch, adapted upon being struck by the arm, to open the switch.

663,209. KNIFE SWITCH; J. A. Wright, Irwin, Pa. App. filed May 16, 1900. A contact having one of its sides formed with a lateral projection adapted to be bent across the path of the switch blade to form a stop.

663,216. RAILWAY TELEPHONE SYSTEM; E. E. Carpenter, Worcester, Mass. App. filed May 25, 1900. (See Current News and Notes.)

663,217. CEILING CUT-OUT; W. A. Church, Pittsburg, Pa. App. filed Feb. 16, 1900. Details.

663,232. SWITCH BOX FOR ELECTRIC RAILWAYS; W. Kingsland, London, England. App. filed July 5, 1900. A box within a box, with sealing devices at the joint between them and constructed so that the parts may be easily separated for inspection and repair, and returned to working position.

663,233. CONNECTION OF STRIKERS TO MOTOR VEHICLES FOR MECHANICALLY OPERATING ELECTRIC SWITCHES; W. Kingsland, London, England. App. filed July 10, 1900. In operating electric switches by tappet action from a motor vehicle running on rails, the striker is connected to the axle so as always to be the same distance from the circuit closer which it strikes.

663,289. DRY BATTERY; E. Meyer, Paris, France. App. filed Nov. 10, 1899. (See Current News and Notes.)

663,304. MAGNETIC SEPARATOR; F. Theilengerdes, Memphis, Tenn. App. filed June 8, 1900. Details.

663,333. FINDER FOR FIREARMS; E. J. Duryea, Dawson, Neb. App. filed Jan. 19, 1900. An electric lamp and reflector are arranged upon a firearm to throw a beam of light through lenses, through which also the target can be sighted.

663,346. ELECTRIC ARC LAMP; W. C. Johnson and A. Wunderlich, London, England. App. filed Sept. 10, 1900. A solenoid and core, consisting of a laminated iron yoke enclosing the coil, and a tubular core having ribs of laminated iron whereby the lamp is rendered capable of operating with alternating current.

663,360. ELECTRICAL RAIL BOND; W. Pervenko, Kiew, Russia. App. filed Dec. 30, 1899. The bond is a steel ribbon extending the full length of the rail and located beneath the same.

663,367. SWITCHBOARD FOR TELEPHONIC OR TELEGRAPHIC PURPOSES; C. Shore, Bolton, and C. Heap, Caldershaw, Rochdale, England. App. filed Oct. 7, 1896. Details.

663,376. ELECTRICAL RAILWAY SIGNALING SYSTEM; L. C. Werner, Louisville, Ky. App. filed Nov. 8, 1899. The system is of that type in which the signal is displayed in the cab of a locomotive, the invention consisting in the details of construction.

663,398. ELECTRIC RAILWAY; E. Sussman-Hellborn and W. Hornauer, Munich, Germany. App. filed Oct. 11, 1900. The cars are fed by induction, the iron magnetic circuit of the primary and secondary being divided between the roadbed and the car and brought into close relation by constructing it of laminations, which dovetail into each other.

663,400. METHOD OF CONTROLLING MECHANISM BY MEANS OF ELECTRIC OR ELECTROMAGNETIC WAVES OF HIGH FREQUENCY; E. Wilson and C. J. Evans, London, England. App. filed July 28, 1898. (See Current News and Notes.)

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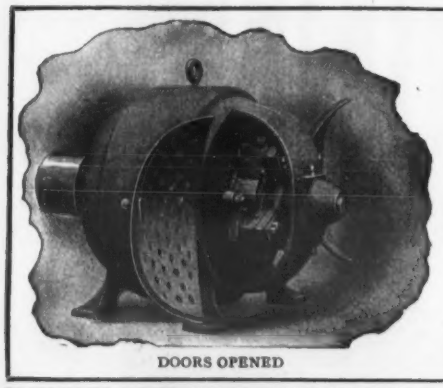

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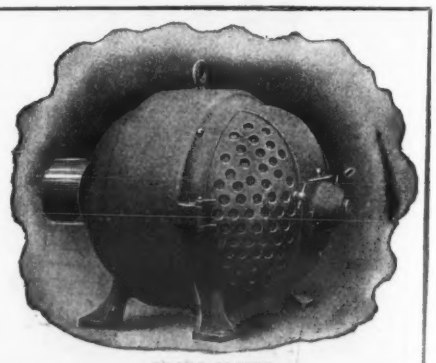

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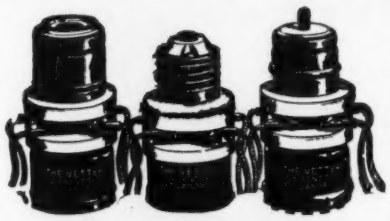

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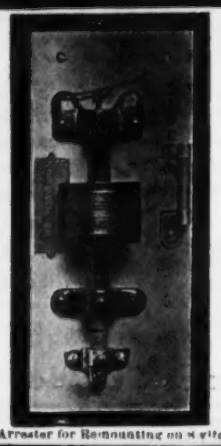
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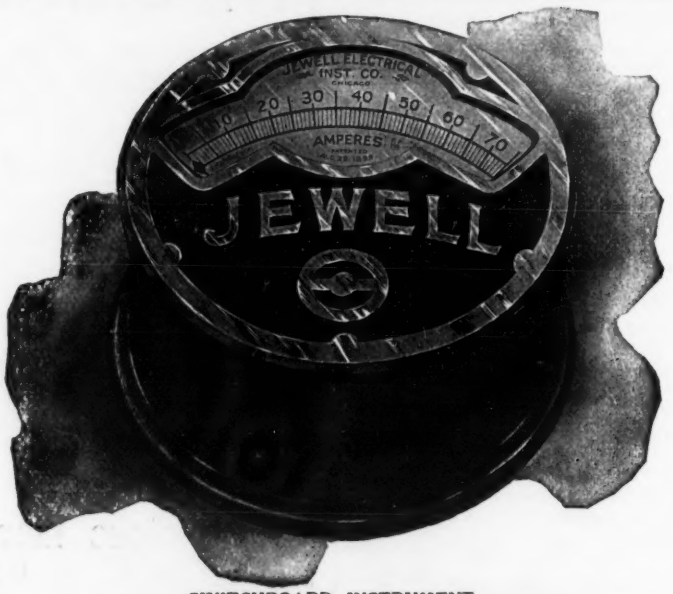

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